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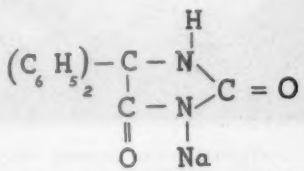
HYPERPLASIA OF THE GINGIVAE ASSOCIATED WITH DILANTIN (SODIUM DIPHENYL HYDANTOINATE) THERAPY

By Irving Glickman,* B.S., D.M.D., and Maxwell P. Lewitus, A.B., C.P.H., D.M.D., Boston, Mass.

SEVERAL reports have appeared corroborating the early observations of Merritt and Putnam[1] concerning secondary symptoms associated with the use of dilantin sodium (sodium diphenyl hydantoinate), an anticonvulsive, in the treatment of epilepsy. Nausea, dizziness, instability of posture, ataxia, nystagmus, blurred vision, dermatitis, itching of the skin and hyperplasia of the gingivae have been noted as complications of dilantin sodium therapy. The primary purpose of this substance is a reduction in the frequency and severity of the epileptic seizures.

This paper is devoted to a consideration of the gingival hyperplasia.

Dilantin sodium is a derivative of glycolyl urea. It is an odorless white powder with a bitter taste, soluble in water, slightly soluble in alcohol and insoluble in benzene and ether. It is administered in capsules. In aqueous solution, it is alkaline to litmus at pH 11.7. Its structural formula is



REVIEW OF THE LITERATURE

In a group of 119 epileptics under treatment with this drug, Kimball[2] made the following observations and deductions concerning the gingivae: 68 per cent of the patients showed some degree of hyperplasia, while 57 per cent using the drug two months or more showed gingival changes, and some who had taken it eleven months showed no change. In clean mouths, the hyperplastic area was firm and smooth, did not bleed and was not tender. No patient with good oral hygiene showed evidence of sponginess or bleeding of the gingivae. Four pa-

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tients had advanced hyperplasia with associated soreness, petechial hemorrhages and gingivitis.

In every case showing gingival hyperplasia, there was an ascorbic acid blood level lower than the normal level, present in those patients in which the hyperplasia did not appear. It was therefore suggested that a deficiency of ascorbic acid paralleled the incidence of hyperplasia in these cases. However, it was also noted that the usual symptoms associated with scurvy were absent.

Gruhzit,[3] investigating a possible relationship between the administration of dilantin sodium and ascorbic acid levels in guinea-pigs, reported that the course of scurvy induced by deficient diet was not modified by the administration of dilantin sodium in daily doses of 50 mg. per kilogram. Normal guinea-pigs did not show any symptoms of vitamin-C deficiency under prolonged treatment with dilantin sodium, and the drug had no effect on the utilization of vitamins B or C.

Fetterman,[4] reporting on a group of twenty-eight epileptics receiving the drug, observed noticeable changes in the gingivae in seven cases. These changes were described as swellings at the root margins which were puffy and whitish and, in some instances, showed increased vascularity. There was no tenderness or bleeding, and only one patient complained of an uncomfortable feeling in the mouth.

In several reports[5, 6, 7] dealing with the use of dilantin sodium in epilepsy, mention has been made of dermatitis with itching and eruptions over the body resembling those of scarlet fever and which disappeared after several days although the drug was not discontinued. No mention was made of a correlated gingival hyperplasia. It is of interest that similar skin eruptions were reported with the use of nirvanol[8, 9, 10, 11] (phenylethyl hydantoin) in the treatment of chorea. In a few of the latter cases, there was spontaneous bleeding from the gums, but no hyperplasia was observed. (Both nirvanol and dilantin contain the hydantoin group.)

Fig. 1.—Typical lesion showing minutely lobulated surface and linear demarcation from labial mucosa; in a man aged 22. The comparative size of the lesion in relation to the mesial portion of the cuspid in the absence of the adjacent tooth is to be noted.

Fig. 2.—Same area as Figure 1, showing marked diminution in lesion eleven weeks after cessation of dilantin therapy.

A review of the cases of gingival hyperplasia reported among epileptics treated with dilantin sodium reveals that Kimball[2] reports an incidence of 57 per cent (group of school children); Merritt and Putnam,[14] 3 per cent (patients of all ages), and Frankel,[12] 62 per cent. The last author also observed what appeared to be a direct relation between the severity of the hyperplasia and the dosage, in addition to a decrease of the

ascorbic acid blood content in proportion to the degree of hyperplasia.

Thoma,[13] in a case report, noted recurrence after surgical removal. He states that "there was no indication that this condition was due to ascorbic acid deficiency."

The present study of gingival hyperplasia associated with dilantin sodium therapy is directed primarily toward making a detailed clinical oral survey to determine the influence of local conditions either in the initiation of the lesion or in the modification of the hyperplasia when this tendency exists. Its purpose is to determine which local conditions, if any, are of themselves sufficient to set up a hyperplasia of the gingivae in epileptic patients receiving dilantin sodium, and to note the nature of the local conditions which are capable of modifying the color, size, shape or consistency of the lesion in those mouths in which a generalized hyperplasia exists.

Fig. 3.—Extensive hyperplasia with comparatively low daily dosage of 0.2 gm. in a girl aged 15. (Courtesy of Dr. Herbert I. Harris, Boston Dispensary.)

Fig. 4.—Same patient as Figure 3; palatal view.

INCIDENCE OF THE LESION

The number of patients examined in this study totaled seventy-six, male and female. The ages of the patients ranged from 15 to 42 years, with an average age of 27.5 years. In the major group of sixty-five, of which ten were edentulous, ten presented hyperplasia of the gingivae. The average daily dosage of dilantin sodium (administered with phenobarbital), was 0.34 gm., with a range of from 0.2 to 0.5 gm. When examined for the first time, the patients in this group had been receiving the drug for an average of four and one-half months, with a range of from one to eight months. Re-examination of these ten patients after an additional five months under treatment with the drug revealed that the hyperplasia had persisted in all cases, showing enlargement or diminution in some as contrasted with apparent stability in others.

Of the remaining eleven patients who came to our attention from different sources, six presented hyperplasia and five did not.

GROSS APPEARANCE

The primary, or basic, lesion is a painless hyperplasia of the gingivae which occurs interproximally, labially and buccolingually in a semilunar distribution circumscribing the necks of the individual teeth. (Fig. 1.) It is mulberry shaped and, when uncomplicated, is firm, pale pink and resilient, presenting a surface that is minutely lobulated with no tendency toward spontaneous bleeding. It appears as follows:

(a) Interproximally as a discrete projection discontinuous with the oral mucosa. As it increases in size, it appears to be ejected from the underlying tissue and, from a papule-like mass, may progress through the stage of a medium-

size, somewhat conical berry-like growth, until it reaches the proportions of a massive tissue fold partially obstructing the tooth from view and possibly interfering with occlusal contact.

(b) On the buccal and lingual surfaces of the molars and bicuspids. Here, the lesion appears along the gingival margin of the teeth. In its earliest stages, it is just visible as a slight linear elevation, which later becomes a prominent ridgelike mass.

(c) In relation to the anterior teeth, with enlargement of the lesion in the interproximal areas. Here, there is a tendency for an approximation of the tabs from the mesial and distal surfaces of the teeth to be joined by the tissue from the labial and lingual surfaces so that, in extensive cases, a v-shaped area of enamel stands out in sharp contrast against the downward projections of hyperplastic tissue. (Figs. 3, 4.)

Fig. 5.—Diminution in size of lesion associated with reduction in secondary inflammatory exudate after scaling and curettage, in a woman aged 23. (Courtesy of Dr. Herbert I. Harris.)

(d) The end result presents a generalized hyperplasia circumscribing the individual teeth, continuous from tooth to tooth, which can easily be separated from the enamel surface and traced to a source of origin which appears to be under the gingival margin. Although its distribution is generalized, there are local conditions which modify it in color, size, shape and consistency.

As stated above, the lesion in uncomplicated cases is coral pink. The most common color changes are associated with an inflammatory response in the underlying connective tissue. In a mouth with a slight distribution of transitory, cheesy *materia alba* and accompanying hyperemia, the lesion becomes a brilliant red. However, with more chronic circulatory disturbances, as seen with calculus or other local irritants, where the circulatory condition approaches venous stasis accompanied by bleeding into the tissues and secondary pigmentation, the lesion turns from light purple to an eventual dusky blue. Patients in whom the gingivae present a general ischemic appearance show an area of hyperplasia which assumes a marked pallor.

DISCUSSION

The size of the lesion varies in different mouths and also within the same mouth. There are individual variations in the gingival hyperplasia in different people as well as variation in the degree of hyperplasia within any mouth. For instance, some cases present a fully developed generalized lesion that is minutely papular and barely discernible, wedging its way between the gingival border and the tooth surface, while others present a hyperplasia of such proportions as to make the teeth barely visible behind overlying curtains of massive gingival exten-

Fig. 6.—Absence of hyperplasia in presence of heavy calculary deposits and lack of attention to oral hygiene, in a man aged 44.

sions. (Figs. 3, 4.) Even within a single oral cavity, the range of hyperplasia may vary strikingly, in accordance with local conditions.

In determining the size of the lesion, it is important to distinguish between the bulk produced by the basic hyperplasia and the increase in size resulting from a complicating inflammatory edema or local occlusal irritation. The most common irritants causing a secondary increase in size are calculus, overhanging fillings, ill-fitting crowns or any condition capable of initiating an inflammatory response with its fluid exudate and edema, as exemplified in those cases under treatment in which removal of local irritants serves only to diminish the complicating edema and discoloration (Fig. 5), the basic lesion retaining its identity or even increasing in size.

Fig. 7.—Contrast in size of lesion mesially and distally to angle of canine eminence, in a woman aged 23.

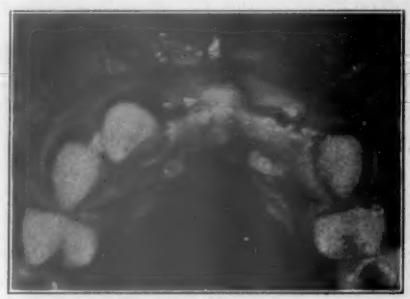

Fig. 8.—Alveolar ridge of patient with generalized hyperplasia fourteen days after removal of upper incisors, demonstrating healing with absence of hyperplasia in tooth-free area, in a boy aged 15.

At this point, it should be emphasized that mouths in which there is a heavy deposition of calculus may be devoid of hyperplasia (Fig. 6.) and, conversely, there are cases in which the oral hygiene is excellent and the lesion profuse, the duration and extent of the dilantin treatment being the same. Of these irritations, then, it may be said that the edema which results is capable of secondarily extenuating the initial hyperplasia, but the nature of their influence is not related to the regulation or initiation of the hyperplastic tendency.

Histologic analysis appears to corroborate the secondary rôle of local irritation in relation to the initial hyperplastic tendency. In addition to a study of biopsy material from advanced cases (Fig. 1), a study was made of a specimen from a very early stage of recurrence, after surgical removal. (Fig. 10.) Examination revealed a non-specific hyperplasia of the epithelium and underlying stroma. (Figure 11, as contrasted with Figure 12, is "normal" gingiva.) The epithelium presents proliferative extension of the basal layer into the proliferating stroma with "rete peg" formation, acanthosis and scattered pearl formation, with no marked hyperkeratosis.

In the advanced lesion, there is an especially pronounced formation of collagen fibrils, condensed in definite bundle formation (Fig. 13), with an increase in adult and young connective tissue cells, blood vessels and intercellular elements. There is considerable infiltration of leukocytic inflammatory exudate, predominantly a small lymphocyte type, with a scattering of plasma cells.

The newly recurrent lesion presents a granulation tissue composed of young blood vessels and young connective tissue cells. There is new formation of collagen fibrils, haphazardly distributed, singly

and in small groups with no definite bundle arrangement. (Fig. 14.) Occasional lymphocytes are seen, but their number is less than that observed in "normal" gingivae. The absence of a marked cellular infiltration in the early recurrent stage, in the presence of definite proliferative changes, as contrasted with the extensive leukocytic infiltration in the advanced lesion, strongly suggests the secondary nature of the inflammatory response.

Tooth irregularity, especially noted in the anterior region, appears to be associated with a preponderance of hyperplastic tissue in those mouths in which the generalized lesion exists. That the end picture in these cases is the resultant of a generalized hyperplasia superimposed upon a gingiva where a localized

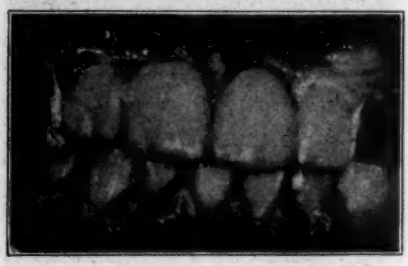

Fig. 9.—"Lesion-free" area under pontics in case of generalized hyperplasia; showing extension of hyperplasia under supplied lateral incisor from upper left cuspid; in a woman aged 28. (The black line in relation to the lower right central incisor is a photographic artefact.)

condition previously had existed in relation to tooth irregularity suggests itself as a possible explanation of this condition. However, we have seen patients receiving dilantin sodium with no sign of hyperplasia even though irregularities of the teeth were present. Apparently, then, these irregularities may be sufficient to encourage the development of hyperplasia where the basic tendency exists, but are not of themselves the mechanism for the initiation of the lesion.

Further observation reveals that the lesions have a tendency to be larger in relation to the labial surfaces of both the upper and the lower anterior teeth. This is particularly marked in the lower jaw, where there can often be noted an abrupt increase in size mesially from the angle of the canine eminence. (Fig. 7.) This situation suggests that perhaps the "dehydrating effect" of constant exposure to the atmosphere, often referred to as complicating various types of "hypertrophic gingivitis," may influence the size of the lesion in these cases.

If the teeth are widely separated, either naturally or as the result of the loss of adjacent members, the lesions tend to be comparatively small in relation to the individual teeth. This condition is clearly demonstrated where the lesions are severe in other areas of the mouth. In some cases, it is interesting

Fig. 10.—Hyperplasia recurring within three weeks after removal of original lesion; in man aged 22.

to observe an extensive tab of tissue in relation to the distal proximal surface of a tooth in contact, as contrasted with a trivial linear elevation of tissue mesially where the adjacent tooth had been lost. (Fig. 1.) It would appear, then, that the self-cleansing effect of food in mastication serves as a prophylactic in those areas where the spacing of the teeth permits free excursion of food.

At this point, it might be well to mention that this hyperplasia has not been observed in edentulous mouths. In those patients with teeth missing, the alveolar ridge in the edentulous areas is lesion-free. This tendency for the lesions to

appear only in relation to supporting structures of the teeth *in situ* is demonstrated in a case of generalized hyperplasia in which it was necessary to remove the upper incisors because of trauma resulting from a blow. Approximately fourteen days after extraction of the teeth, the alveolar ridge in the area gave no evidence of hyperplasia, the basic lesion remaining generalized throughout the remainder of the mouth. (Fig. 8.)

Two other cases are of interest in this respect. In each, the maxillary incisors were replaced by pontics supported by crowns on the cuspids, and in each there was a generalized hyperplasia in relation to the remaining teeth. A careful examination of the alveolar ridge under the facings revealed that neither case showed hyperplasia in this area. The mucous membrane in one was pale, firm, pink and smooth. (Fig. 9.) In the other, where the generalized hyperplasia had been complicated by secondary inflammatory processes, it was not immediately possible to distinguish a clear-cut separation demarcating the tooth-free area from the hyperplastic tissue around the neighboring teeth. On removal of the local irritants by scaling and curettage in the latter case, the basic hyperplastic lesion persisted throughout the mouth while the normal mucous membrane covering the alveolar ridge beneath the pontics was revealed in sharp contrast. These cases appear to corroborate the earlier observations regarding the significance of local irritation in relation to the hyperplasia, in addition to the fact that tooth-free areas are lesion-free.

The firmness and resiliency of the hyperplastic region may be secondarily altered by the fluid exudation and superficial ulceration which accompany local involvement, so that different stages in consistency are presented, varying from firm resistance to palpation to friable ulceration.

Because of the nature of this gingival hyperplasia, and because the intricate mechanism of its etiology has yet to be determined, our present knowledge per-

Fig. 11.—Proliferative extension of epithelium, "rete peg" formation with proliferation of underlying stroma and leukocytosis; biopsy specimen from case shown in Figure 1. (Hematoxylin and eosin stain; obj. 10; homol. 2; ×66.)

Fig. 12.—"Normal" gingiva, labiolingual section through tip of free margin, in a man aged 26; showing epithelium-connective tissue relationship and distribution of collagen. The lower region of the section shows area of lymphocytosis invariably associated with base of gingival crevice. (Hematoxylin and eosin stain; obj. 20; homol. 2; ×124.)

mits but two empiric approaches: cessation of the drug or local therapy.

In two cases in which it has been possible to substitute another drug for dilantin sodium, the following has been noticed:

1. A gradual diminution in size of the lesion, which began shortly after the dilantin was withdrawn, the lesion, after four weeks, being of barely discernible linear form. In this case, the oral hygiene was poor, with generalized caseous *materia alba,* which was not removed during the period the patient was being studied.

2. A gradual diminution in size of the lesion, which, after eleven weeks, was still visible. (Fig. 2.) The patient had failed to respond to curettage and repeated excisions over a period of a year before removal of the drug was attempted. In this case, the oral hygiene was excellent.

The course of these cases is in line with our earlier observations of the comparative unimportance of local irritants as primary etiologic agents. The latent period which exists before complete recovery of the gingival tissues suggests a protracted effect of the drug even after administration is stopped. Complete disappearance of the hyperplasia has not been obtained in either case. In our experience with local therapy for control of the lesion, scaling and curettage coupled with improved local hygiene have been effective in eliminating inflammatory complications, but have been of little avail in either diminishing the size of the hyperplastic area or limiting its growth. In cases under observation and local treatment, fluctuations in the size of the basic lesion have occurred spontaneously without relation to frequency or degree of curettage. Surgical excision has been of only temporary value, indentical lesions recurring in a short time.

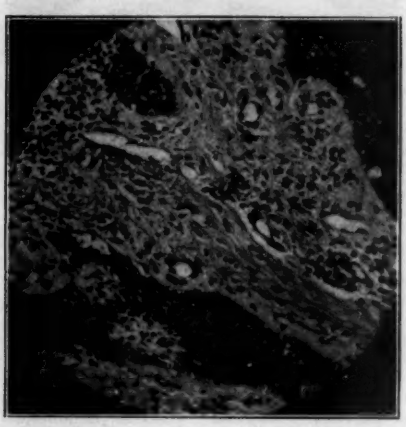

Fig. 13.—Area X, Figure 11, higher power; showing condensed bundle arrangement of collagen fibrils, capillaries and leukocytosis. (Hematoxylin and eosin stain; obj. 40; homol. 2; ×230.)

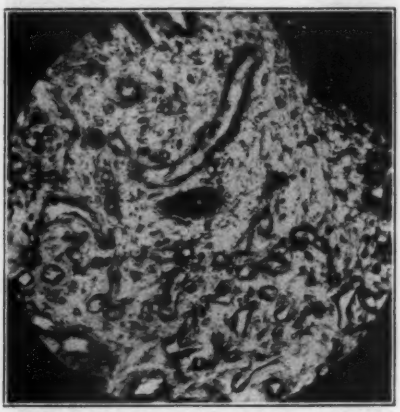

Fig. 14.—Newly recurrent lesion, biopsy specimen of case shown in Figure 10; showing predominance of newly formed capillaries, young connective tissue cells and distribution of collagen fibrils. (Mallory's aniline blue connective tissue stain; obj. 40; homol. 2; ×280.)

SUMMARY

1. Hyperplasia of the gingivae may occur as a secondary reaction in the treatment of epilepsy with sodium diphenyl hydantoinate.

2. When uncomplicated, the hyperplasia is painless and the tissues are firm and resilient, presenting a minutely lobulated surface.

3. Changes in size, shape, color and consistency associated with various local

conditions are secondary to the primary hyperplastic tendency.

4. Complication by secondary inflammatory changes and edema results in a diffuse increase in size and bulging away from the tooth surface, the surface demarcations of the individual lobules becoming less and less pronounced. This can readily be distinguished from the progressive growth resulting from a continued uncomplicated hyperplasia.

5. The course of the basic condition is a chronic one with fluctuations in severity apparently unrelated to local influences. Spontaneous disappearance, however, has not been observed.

6. Although a relationship between vitamin C deficiency and the incidence of hyperplasia has not been observed, the few cases studied in this respect do not warrant any conclusion.

7. No correlation was noted in this study between the severity of hyperplasia and the dosage of dilantin sodium administered. Conclusions in this matter await further observation and analysis.

8. The question of age incidence in relation to the initiation and severity of the hyperplastic tendency is suggested for further investigation.

COMMENT

The questionable wisdom of attempting to interpret gingival disturbances as isolated local oral phenomena is strikingly demonstrated by the material here presented.

Since the maintenance of the health of the supporting structures evidently is a function of a complex body physiology, a consideration of this body physiology must be the starting point for any clinical approach to periodontal disturbances. Continued stress upon the arbitrary division of the factors contributing to periodontal pathology into so-called "local" and "systemic" categories has been of little avail toward effecting a solution to this problem. . . . This superficial attempt to pigeon-hole natural phenomena disregards the basic nature of the processes involved and is merely productive of a shroud of insignificant technicalities.

In the final analysis, the systemic background of the patient is the keynote of the periodontal structures. It is upon this background that our efforts should be focused. For it is only with an understanding of its intricate influences upon the periodontal structures that the relative significance of local external forces will become self-evident.

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TREATMENT OF BENIGN TUMORS OF THE JAW

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BENIGN tumors of the jaw occur from two sources: (1) the tooth germ tissues, during tooth development, or (2) epithelial remnants retained in the jaws. They may be either cystic or solid in character. The purpose of this paper is to discuss the surgical treatment of cystic tumors of the jaw only, which may be divided, in order of frequency, into the following groups: 1. Dental root cysts, also called radicular or peridental cysts. 2. Follicular cysts, also called dentigerous cysts. 3. Traumatic cysts. 4. Incisive canal cysts. 5. Adamantinoma.

These groups have been subdivided according to the pathologic picture presented. However, a discussion of the microscopic pathology involved is not within the scope of this paper, and those tumors that are treated alike will be dealt with in one group, regardless of etiologic or pathologic differences.

ETIOLOGY

Dental root cysts, follicular cysts and traumatic cysts differ etiologically. The first type is caused by chronic irritation at the apex of a devitalized tooth. A follicular cyst is caused by irritation from an impacted or unerupted tooth. Traumatic cysts are found to be cavities within the bone, filled with blood, but with no lining membrane. A less common cyst is the incisive canal cyst, in the anterior palatine region. Clinically, these cysts have many points in common. They grow slowly and form a definite cavity, which is surrounded by healthy bone. They usually do not cause any discomfort, especially in the early stages, unless the fluid in the cavity becomes infected. These cysts, especially dental root and follicular cysts, may assume a large size, and may weaken the jaw bone. They are benign and their destructive effect is only local. Owing to common characteristics, their distinction is academic and has no bearing upon the methods of treatment.

DIAGNOSIS

Many dental cysts are discovered accidentally during routine dental x-ray examination. Because of absence of pain and discomfort, the patient is unaware of their development. Occasionally, the abnormal bulging of the alveolar plate suggests the presence of a lesion. X-ray examination is the principal means of diagnosis, yet it may be difficult to differentiate giant-cell tumors and adamantinomas, metastatic tumors of the jaw and myelomas by this method alone.

A giant-cell tumor, if small, can be differentiated only if explored, the contents of the cavity being a soft, solid tumor mass. A large giant-cell tumor, which tends to grow toward the surface, causes considerable distortion of the normal contour of the mandible. The x-ray outline of the larger cavities is often suggestively lobulated and trabeculated.

An adamantinoma usually shows an interrupted outline of the cystic cavity with small accessory cavities. It has a marked tendency to expand the bone and to disturb the normal outline.

TREATMENT

Treatment of dental cysts is frequently discussed in dental literature, and many

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methods of surgical procedure are advocated. No single surgical procedure is applicable to all types of cases. The anatomic location, the size and, to a certain extent, the type of infection of the cystic fluid should determine the operative procedure.

In general, operative treatment of dentocystic tumors, whether radicular, dentigerous or traumatic, consists of (1) exposing the cavity; (2) removing the cystic contents and the membrane, and (3) eliminating the cavity. The last procedure, being the most important factor in the treatment, requires special consideration. There are several methods that can be followed for the obliteration of the cystic cavity.

A. The simplest and most desirable is the so-called closed method, consisting of extraction of the offending tooth with free exposure of the cystic cavity through the buccal alveolar plate. After removal of the membrane, the reflected mucoperiosteum is sutured back into its original position. Under favorable conditions, the blood clot is allowed to organize in the same manner as in a socket from which the tooth has been extracted. This method, unfortunately, is only suitable for small cysts, not over 2 cm. in diameter.

B. In larger cysts, one of the most commonly used methods consists of repeated packing of the cavity after the buccal aspect of the cyst is completely exposed and all the overhanging edges of bone and the cystic membrane are completely removed. This method undoubtedly has great merit in large cysts of the mandible, especially if they have been previously infected. The main disadvantage, however, is that the healing process of the wound is unduly prolonged.

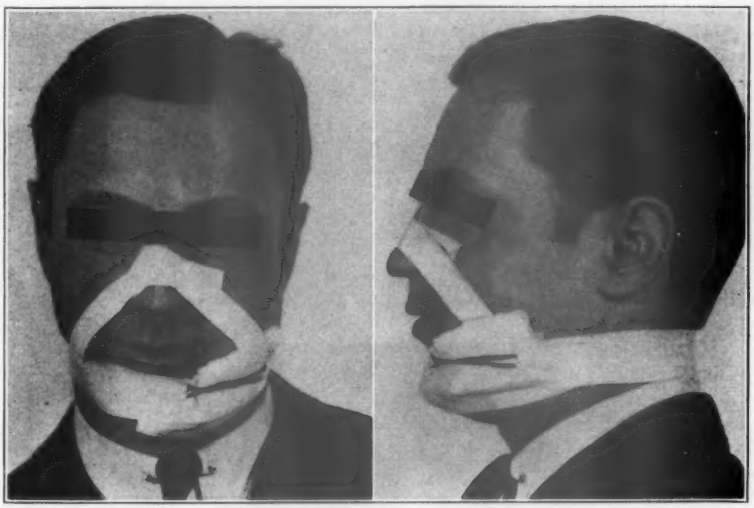

Fig. 1.—External pressure bandage. A pad of gauze presses the cheek tissues against the operative area, and rubber elastics exert pressure.

C. The obliteration of large cystic cavities in the mandible is more easily accomplished by the so-called flap operation. In 1926, Harrison advocated the complete extirpation and elimination of the cavity by the mucoperiosteal method. His procedure consisted of exposure of the cyst by making a broad buccal flap, and removal of the membrane in the

usual manner. The buccal flap was lengthened by extending the incision at each end of the original flap, which was in turn drawn into the cystic cavity and held in that position with mattress sutures through the lingual plate. Harrison's method is especially suitable for cysts in the body of the mandible. However, the following method is advocated as a simpler modification.

The modified method consists of (1) exposing the buccal surface of the mandible by separating the mucoperiosteum from the gingival margin almost to the lower border of the mandible; (2) removing the entire buccal plate covering the cystic area, trimming little, if any, of the bone of the lingual plates; (3) removing the entire cystic membrane; (4) permitting the buccal mucoperiosteal flap to fill the cavity, which is made easier by cutting through the periosteal layer along the base of the flap, allowing part of the cheek tissues to come forward and fill the cavity, and (5) employing an external pressure bandage to force the

Fig. 2.—Two extensive cysts of mandible. The larger one, on the left side, was exposed through the buccal alveolar process and permanent drainage established.

Fig. 3.—Case in Figure 2, six months later; showing that mere drainage had gradually reduced cyst.

tissues into the cavity and to eliminate the existent space.

An external pressure bandage can be applied easily by the following method: A strip of adhesive plastic from ¾ to 1 inch wide and long enough to pass around the back of the neck and overlap at the symphysis of the chin or the middle of the upper lip 4 inches each way is applied. Where it passes around to the back of the neck, a 6 to 8 inch piece of adhesive is laid on the long strip, gummed sides together so that the adhesive will not stick to the neck. A gauze pad is placed externally on the face over the area operated upon and the adhesive strip passed, under tension, over it. Additional pressure can be applied by a second pad, placed outside,

Fig. 4.—Typical dental root cyst. These cysts rarely assume a large size.

over the area operated upon on the adhesive pressure strip, over which is stretched one or more elastic bands attached at each end to the basic adhesive strip by strips of adhesive plaster. Additional support for the pressure bandage can be had by short strips of adhesive tape passed up and crossed over the bridge of the nose. A pressure bandage is ordinarily left in place twenty-four hours. (Fig. 1.)

CONSERVATIVE METHOD

Russell, in 1936, published an article advocating conservative treatment of cysts, consisting of a small exposure of the cystic cavity through the buccal mucous membrane, evacuation of the cystic fluid and use of a butterfly-shaped rubber drain to make a semipermanent opening into the cyst. This treatment is based on the supposition that "bone cysts cannot function and grow except by their own internal circulatory pressure," and "when the cystic pressure is relieved, the secretory cells cease to function, atrophy and disappear."

It is true that cysts of the jaws, being artificial cavities, tend to grow gradually smaller if constant drainage is applied. From that point of view, this method has great merit for special types of cases, especially in multiple dentigerous cysts occurring in children, when open treatment would endanger the vitality of many teeth. This method could also be used as a preliminary step to further operative treatment by diminishing the size of the cavity. However, the method is rather slow, and one never has the assurance that the entire cavity will eventually be eliminated.

The following case is an example of a judicious use of this method.

A man, aged 45, had two large cystic cavities, one on each side of the mandible. (Fig. 2.) The cyst on the left side was infected and so was opened for drainage. The cystic cavity extended over the greater part of the ramus and anteriorly as far as the cuspid tooth. The patient had a full set of vital teeth. As a radical operation would have meant a good deal of mutilation or loss of the posterior teeth, it was decided to use a conservative method by establishing semipermanent drainage. Six months later, x-ray examination showed (Fig. 3) that the cavity was smaller and there was marked formation of bone in the ramus of the mandible. However, there was no diminution in size of the anterior part of the cyst and, moreover, there was a considerable depression at the exposed part of the mandible.

In this case, undoubtedly, complete extirpation of the cystic membrane will eventually be necessary, but resulting operative trauma will be less extensive.

PARTSCH OPERATION

In the Partsch operation, which has many advocates, the cystic cavity is exposed in the usual manner. All the overhanging edges of bone of the buccal plate, as well as the membrane of the attached buccal plate, are trimmed, but the membrane covering the lingual plate is left intact. The theory underlying this operative procedure is that, after the mouth wound heals, the cavity gradually becomes smaller and the intact cystic membrane joins the normal epithelium of the buccal cavity. It is chiefly useful in the treatment of large mandibular cysts; yet the resulting depression of the buccal aspect of the jaw is objectionable, since food particles and secretions are apt to accumulate there.

Incisive canal cysts (Fig. 4), which are found in the incisive region of the maxillae, have no etiologic relation to dental cysts connected with a central incisor, but probably arise from epithelial remnants in the nasopalatine duct. These cysts, which are always situated at the median line, rarely grow to great size. Occasionally, when infected, they cause swelling and tenderness in the anterior palatine region. The differential diagnosis depends on the following conditions: 1. The incisor teeth are vital. 2. Growth of the cyst causes bulging of the palatine mucous membrane. 3. The cysts are found at the median line.

Fig. 5.—Retouched x-ray photograph showing extent of dental cyst encroachment upon maxillary sinus.

The natural operative approach to incisive canal cysts is through the palatine mucous membrane.

CYSTS OF THE MAXILLAE

Treatment of large unilocular cysts of the maxillae should be considered separately because this bone differs anatomically from the mandible, being com-

posed of a series of thin bony partitions that help to form the outlines of the nasal cavity and maxillary sinus. Cystic tumors, unless treated early, tend to grow posteriorly or medially until they eventually encroach upon the maxillary sinus or nasal cavity. Their progress is usually slow and painless, but steady.

The partition between the maxillary sinus and the cyst is at first composed of a thick layer of bone. As the cystic cavity grows larger, this bony partition is gradually resorbed, until the mucous membrane covering of the cyst and the antrum adjoin one another. Often, the pressure of the cyst pushes this membrane toward the lateral wall of the antrum, eventually obliterating the greater part of the maxillary sinus. During this process of expansion, the lining membrane of the antrum does not disappear, but becomes folded upon itself, a very thin space remaining for secretions to seep through and, usually, the superior posterior remnant remaining. (Figs. 5-6.)

The recognition of these cysts is not difficult, their presence often being discovered during a routine x-ray examination of the teeth. At times, however, puzzling conditions arise as the cyst, because of its size, can easily be confused with the sinus. The normal contour of the maxilla may not show any changes, but it is not unusual to find abnormal swelling of the buccal as well as the palatal sides of the alveolar processes. The following points will assist in the final diagnosis:

1. The cystic cavity has no outlet, and the maxillary sinus has a normal ostium under the middle turbinate.

2. A roentgenogram taken by a competent roentgenologist often shows the outlines of both cyst and sinus.

3. The cystic cavity, if not infected, will contain a straw-colored fluid, which is characteristic. If infected, it will contain a thick, grayish cheesy substance.

4. The cystic membrane is covered with columnar or cuboidal epithelium, while the normal membrane of the antrum is composed of ciliated epithelium.

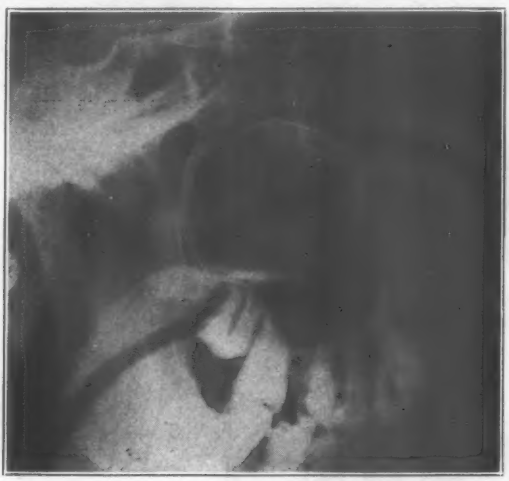

Fig. 6.—Retouched x-ray photograph showing cyst of upper jaw almost obliterating maxillary sinus.

TREATMENT

The patient may not suffer any discomfort even from the presence of a

large cyst as long as the fluid content remains sterile; but if the cyst is infected, the patient may be expected to have all the symptoms of a chronic or an acute infection.

Here again, the operative treatment of a large cyst resolves itself into the elimination of the cavity. The simplest way to accomplish this is to join the cessible to the cystic cavity. (Fig. 7.) The mucoperiosteum is carefully separated from the bony shell or, in the absence of bone, from the cystic membrane, until the bony surface over the upper border of the canine fossa is reached. This will afford a good-sized opening, through which the cystic membrane can be stripped from its base. The

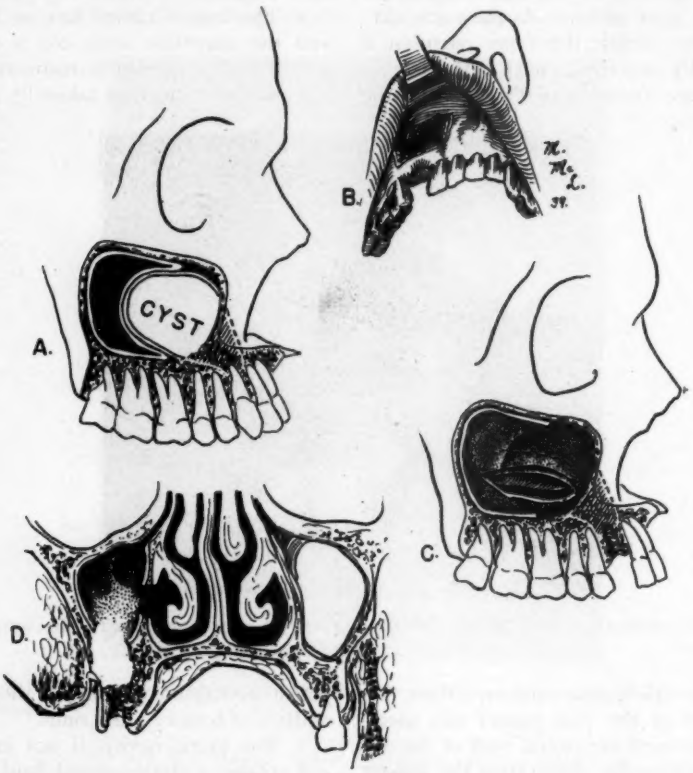

Fig. 7.—A, diagrammatic drawing of cyst extending into maxillary sinus. B, exposure of cyst through anterior buccal plate. C, cystic cavity removed and partition between cyst and antrum obliterated. A large intra-nasal opening has been made under the lower turbinate for drainage. D, sagittal view, showing obliteration of cystic cavity and intranasal opening under lower turbinate. The buccal opening has been closed.

cystic cavity with the maxillary sinus.

I have used the following procedure since 1922: A horizontal incision from 1 to 1½ inches long is made over the buccal alveolar process most easily accavity is carefully inspected, and the absence of an ostium leading to the nasal cavity will verify the diagnosis of a cyst. The wall separating the maxillary sinus from the cyst is obliterated and the sharp

bony edges along the border are trimmed. A large opening is then made under the lower turbinate, forming a communication between the antrum and the nasal cavity. Usually, it is not necessary to use packing. The mouth wound is closed with silk sutures.

These operations may be performed under local or general anesthesia, according to the extent of the cyst and the temperament of the patient. The patient should be hospitalized for a few days as there may be considerable swelling of the face, a certain amount of pain and occasional bleeding. After the first week, however, very little care is needed.

Occasionally a cyst originating from a devitalized upper anterior tooth grows and extends backward toward the palate and under the floor of the nose. On examination, one sometimes sees a definite change in the contour of the palatal arch as well as in the contour of the floor of the nose. The elimination of this cavity

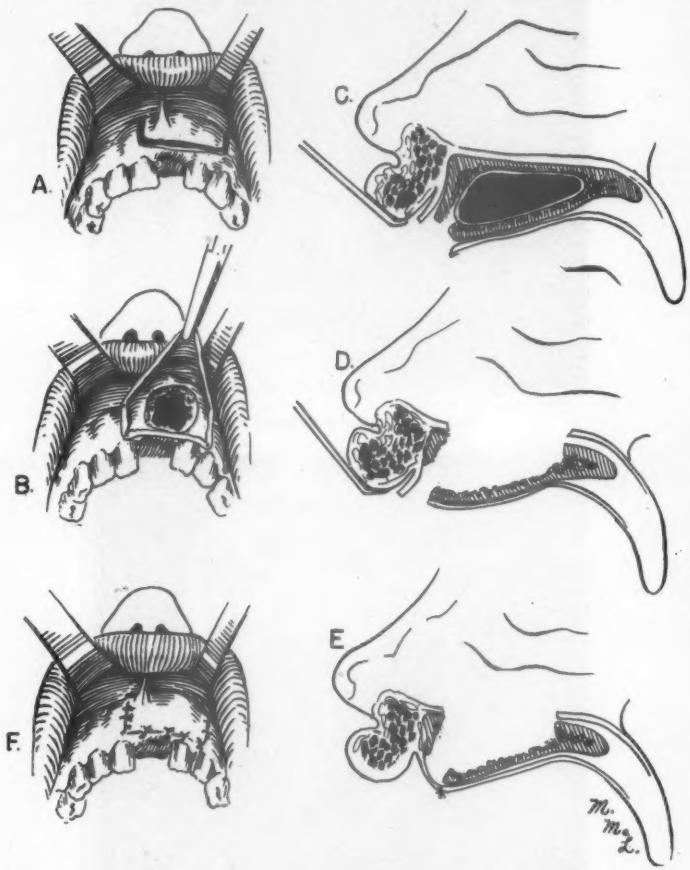

Fig. 8.—Diagram showing cyst extending along floor of nose. Through the anterior buccal approach, the cystic membrane was removed. The roof of the cyst was then excised, the cyst being joined with the nasal cavity. The buccal opening was then closed.

by repeated packing will eventually lead to a deep cavity, which is undesirable. The following operative procedure has not previously been described. (Fig. 8.)

The nasal cavity, especially along the floor, is packed with gauze saturated with a 10 per cent cocaine and epinephrine solution, while the palatal and buccal mucous membrane is infiltrated with 2 per cent procaine solution. The involved teeth are first extracted. A U-shaped incision is made and the buccal mucous membrane is reflected. This incision exposes the entire anterior surface of the alveolar process. The cystic cavity is exposed by removing as much bone as is necessary from the buccal alveolar plate, and the contents of the cyst are evacuated. If the cavity is not infected, the straw-colored fluid is easily sponged out;

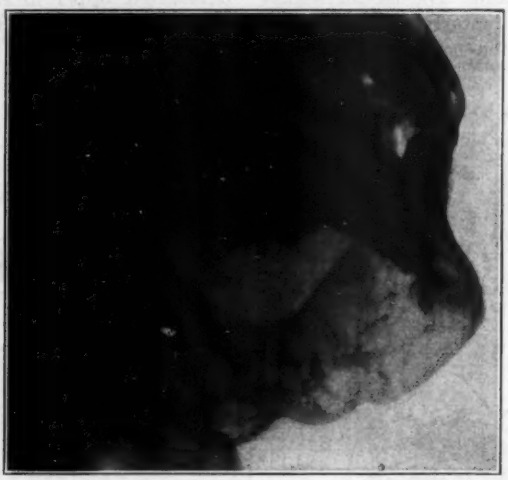

Fig. 9.—Typical adamantinoma.

Fig. 10. (Case 1).—Giant-cell tumor.

but if the cyst has already become infected, one not infrequently finds yellowish green thick pus, which must be removed, after which the cavity is thoroughly cleaned. If the cystic membrane is found to be sensitive, infiltration of procaine through the operative field is effective; and usually cocaine packs in the floor of the nose result in an effective anesthesia in that field.

The cystic membrane is carefully separated from the bony wall with a fine periosteal elevator. Not infrequently, the bony shell in the center of the cyst is completely resorbed, so that, in separating the membrane, one must be careful not to perforate the palatal mucous membrane.

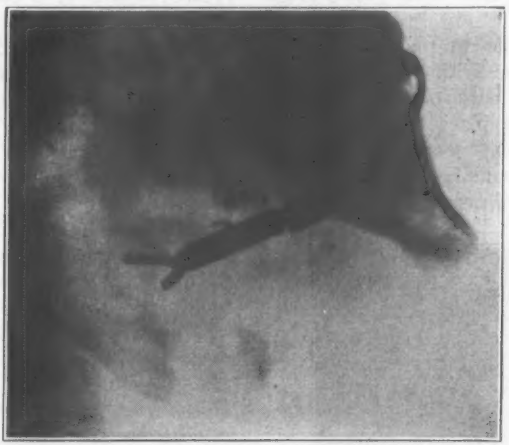

Fig. 11 (Case 1).—X-ray appearance after removal of tumor including section of mandible. The main fragments of the mandible are held apart with a dental splint.

Fig. 12 (Case 1).—X-ray appearance three years after operation (transplantation of bone).

Elimination of the cavity is accomplished by connecting the cystic cavity with the nasal cavity. To do this, it is necessary to remove the mucous mem-

brane and also the bone that separates the floor of the nose from the cyst. All the bony projections should be trimmed so as not to allow any blind pockets. The bleeding is stopped, and the buccal mucous membrane flap is brought down to its original position and sutured in place, the cystic cavity thus being joined to the nasal cavity.

It is advisable to pack the cavity, through the nose, with sterile gauze impregnated with boric ointment, keeping the packing in place for twenty-four hours, to prevent possible hemorrhage from the nasopalatine artery after the effect of the procaine anesthesia has dis-

Fig. 13 (Case 2).—Appearance of patient with large adamantinoma of jaw.

appeared. Usually, not a great deal of after-care is necessary in these cases. The patient is given neosilvol drops (in 10 per cent solution) to use in the nose three times a day. Occasionally, when there is any evidence of accumulation of secretions, it is necessary to douche the nose. The healing process is rapid, and the floor of the nose re-forms itself without leaving any trace of the cystic cavity.

ADAMANTINOMAS

Adamantinomas (Fig. 9) are variously called multilocular cysts, polycystic ameloblastoma, etc. This type of tumor, which is rare in comparison with the other dentogenic cysts, requires special consideration as it is a true epithelial tumor, being commonly thought to originate from the epithelial cells of the enamel organs. It is more destructive of normal bone of the jaws and therefore locally malignant, and, if imperfectly treated, it is liable to undergo malignant degeneration and invade the neighboring soft tissues. This tumor is often found in young adults. It grows slowly and painlessly like other cysts of the jaws and is found more frequently in the mandible. The favorite location is at the angle of the jaw or at the symphysis. The x-ray picture is quite characteristic, showing multiple small cystic cavities separated by thin fibrous or bony septa. The cavities usually contain brownish fluid. Some of the cavities may be filled with a soft solid tumor mass. As they grow larger, expansion of the bony plates results. Their extreme boundaries are not so sharply outlined as in the other dental cysts. Differential diagnosis of adamantinomas is not always easy. The x-ray picture is often similar to that in osteitis fibrosa cystica, benign giant-cell tumor or ossifying fibroma. Therefore, if radical treatment seems to be necessary, it is important to have a biopsy. Unfortunately, the diagnosis of adamantinoma is not often made in its early stages, and the destructive process advances to such a point that a radical operation is necessary. For early diagnosis, it is important to submit the membrane of every dental cyst to a pathologic examination, particularly if it shows a thick membrane with overlapping of papillomatous masses, or shiny lobulated surfaces.

The treatment is surgical, and it is essential to remove more bony tissue than appears to be involved in the x-ray picture. Often, the entire thickness of the jaw is involved, and resection of the mandible is at the present time accepted

as the only method promising a complete cure.

Unfortunately, most cases of adamantinoma of the mandible require a radical operation, which becomes a mutilating one. If the tumor is in the anterior part of the jaw, the removal of a median section will leave a gross deformity, and loss of the coordinating action of the remaining segments of the mandible will create a difficult reconstructive problem. On the other hand, if the tumor mass has extended toward the ramus, unilateral resection of the jaw becomes a necessity, with its subsequent deformity. Therefore, in the treatment of large adamantinomas, the operative procedure must

necessary to give a detailed description of the operative procedure for the radical removal of adamantinomas, but one point deserves emphasis: In all pathologic conditions necessitating removal of the ramus of the mandible, the surgeon should spare the head and neck of the condyle if they are not invaded by disease, as future reconstruction by bone grafting is more favorable if the head of the mandible is present.

The loss of continuity of the mandible, whether from trauma or following operation for removal of tumors, is accompanied by definite loss of function of the mandible. The muscles of mastication lose their normal coordinating ac-

Fig. 14 (Case 2).—Adamantinoma of jaw.

be considered only as the first step. The second step is the correction of the deformity and the restoration of the dental apparatus to a reasonably serviceable condition.

Treatment of the deformities caused by radical operation in adamantinoma should be paramount in the surgeon's mind. It is the duty of the oral surgeon not only to cure the disease, but also to restore the mouth cavity and its dental apparatus to a serviceable condition. Before resection of a part of the mandible or maxilla, certain preoperative measures should be undertaken as a preliminary step toward further restoration. It is not

tion. As a result, they pull the segment of the mandible to which they are attached independently of the corresponding muscles of the opposite side. This muscle pull, combined with cicatrization from healing of the operative wound, greatly reduces the functioning of the remaining parts of the mandible.

The first duty of the surgeon, in this respect, is to prevent permanent distortion of the remaining parts of the mandible. These parts should be kept in their normal anatomic position immediately after the operation. For this purpose, it may be necessary to construct dental splints of suitable design prior to the

operation. It is easier to control the remaining part of the mandible at this stage than after secondary changes have taken place.

In the treatment of mandibular defects resulting from operative treatment of adamantinomas and giant-cell tumors, two procedures are available: (1) transplantation of bone and (2) construction of prosthetic appliances. Transplantation of bone is the method of choice and eventually the most satisfactory to the patient. However, owing to operative difficulties or the patient's condition, it is at times advisable to employ a prosthetic restoration as a temporary measure or permanently. It is beyond the scope of this paper to discuss the various problems associated with the transplantation of bone or the construction of appliances. However, a case will be cited to illustrate some of the points emphasized above.

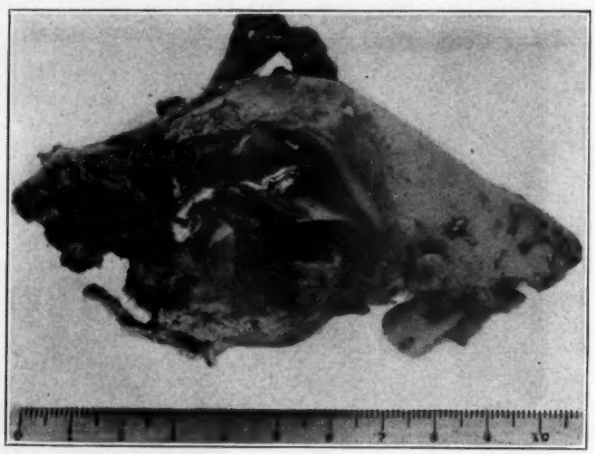

Fig. 15 (Case 2).—Gross pathologic specimen.

GIANT-CELL TUMORS

Giant-cell tumors, which occur on the long bones as well as in the mandible and maxillae, are single or may be multiple, as when several lesions appear in different parts of the skeleton. In this connection, giant-cell tumors are often closely associated with hyperparathyroidism (parathyroid dysfunction).

In the maxillae and mandible, we usually find benign single tumors, and these are divided into two main groups: peripheral giant-cell tumors and central giant-cell tumors.

The peripheral type, which is usually soft and deep red or mottled, is usually found on the alveolar processes close to the teeth. It bleeds quite readily, and the base is wide and firmly attached to the bone, which shows a considerable amount of resorption in the x-ray picture. This tumor is often confused with the so-called epulis, a true fibroma which does not contain giant cells. Epulis, which usually grows slowly, originating from the periosteum or peridental membrane, does not destroy bone. The surface is firmer and smoother than that of the giant-cell tumor.

The central type of giant-cell tumor originates from the cancellous part of the bone. Its favorite site is considered to be that part of the maxilla or mandible originating from cartilage. It is more often found at the angle of the jaw and at the symphysis. As the tumor mass

grows larger, it causes resorption of cancellous bone, while the cortex becomes thin and expanded; or it may eventually be destroyed. The x-ray picture of the giant-cell tumor is not unlike that of a single dentigerous cyst. The walls surrounding the tumor are quite sharply outlined. The bony trabeculae, which vary in size, are often found extended through the tumor. On section, the tumor mass is somewhat gelatinous, while under the microscope one sees multinucleated giant-cells in stroma of loosely woven cellular connective tissue.

Giant-cell tumors of the jaw are considered benign. Although they cause destruction of healthy tissue by expansion, they do not metastasize or extend into the lymphatic tissue.

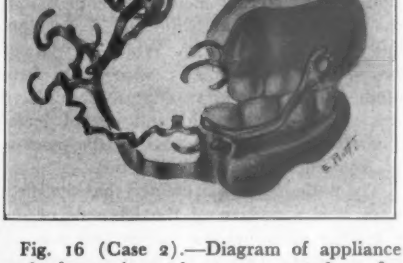

Fig. 16 (Case 2).—Diagram of appliance made for patient who was operated on for adamantinoma of left mandible. The missing bone extended from the left bicuspid region backward. The appliance consisted of two dental plates connected by a bar at the upper end of which was a hinged joint. The fork at the lower end rests on a small bar incorporated in the lower plate. As the mouth opens, there is no disturbance of the lateral motions of the jaw. When the teeth are in contact, the bar forces the lower jaw into normal position.

TREATMENT

These tumors are highly resistant to radiation therapy. A complete removal of the mass by surgery is by far the method of choice. They are known, however, to have a tendency to recur. For this reason, some authorities recommend curetting the bony cavity thoroughly after shelling out the tumor. This is followed by radiation therapy or cauterization of the surface of the cavity with an escharotic solution.

Giant-cell tumors, however, originating within the bone may cause enough destruction to justify the removal of a section of the mandible.

REPORT OF CASES

CASE 1.—*History.*—S. L., a boy, aged 12, gave a negative history with the exception of a few colds and a tendency to faint following any injury such as cutting a finger. About two years before his first admission to the Massachusetts General Hospital, August 1, 1925, his parents noticed a swelling over the right cheek, which proved to be caused by a tumor mass on the lower jaw. This mass increased in size during the next two to three months, and the patient was operated upon at a local hospital. The parents said the tumor mass was punctured and medicine was put in it. Convalescence was uneventful. For the next two to three months, the mass was smaller, but it then began to grow, becoming larger than it had previously been.

Examination.—Examination on admission revealed a hard swelling of the right side of the face involving the mandible. There was no tenderness or discoloration of the skin. The tumor mass was smooth in contour and firmly attached to the bone, extending from the angle of the jaw almost to the median line. The x-ray picture showed a cystlike mass occupying the greater part of the body of the mandible. (Fig. 10.) The mass, which was sharply lobulated, contained coarse trabeculae. The diagnosis was "sarcoma or giant-cell tumor." Operative treatment was advised. Previous to operation, models were made and a splint was constructed.

Operation.—The operation was performed under avertin (tribromethylalcohol) and intranasal ether. A semicircular incision of about 15 cm. was made, extending upward toward the lip. The right side of the body of the mandible was excised with saw and bone-cutting forceps. The wound of the floor of the mouth was closed, and the skin closed over a pad and rubber drain. The previously prepared splint was adjusted, encircling several of the teeth on the left and, by an ad-

justable fork, engaging the stump of the ascending ramus on the right side. It was then wired into position.

Outcome.—The patient made an uneventful recovery and was discharged from the hospital August 30 with the appliance in position. He was advised to return on September 9. (Fig. 11.)

Pathologist's Report (1)—An encapsulated tumor, 7 cm. long and 5 cm. wide, was almost entirely on the lateral surface. The major portion was composed of moderate-sized polyhedral cells, the latter showing a moderate mitosis. A number of areas showed collections of giant cells of the benign giant-cell tumor type. The findings were sufficient to classify the lesion as slowly growing osteogenic sarcoma.

(2) Further sections made the previous diagnosis unlikely, the number of mitotic figures and increased cellularity being explained on the basis of the earlier operation. The later sections showed more giant cells of the benign type. The lesion was, therefore, classified as a benign giant-cell tumor.

Second Admission (January 23, 1933).—The boy was in good physical condition, and there was no evidence of recurrence of the tumor. It was decided to operate and transplant an osteoperiosteal graft.

Operation: An incision was made along the old scar and the mandibular stumps were freely exposed. Two pieces of osteoperiosteal graft about 4 inches long and one-half inch wide were removed from the left tibia and transferred to fill the gap in the mandible. The transplants were held in position by buried sutures. The jaws were then immobilized by wiring.

Outcome: The patient made an uneventful recovery and was discharged from the hospital February 8, 1933. (Fig. 12.)

CASE 2.—*History.*—M. G., a woman, aged 43, first seen November 29, 1937 (Fig. 13), gave a history of an operation on the left lower jaw in 1929, in which the laboratory diagnosis was probably adamantinoma. Thereafter, she did not have any trouble until two years previously, when the left side of the face showed signs of swelling. Examinations, in 1937, revealed a large bony tumor extending from behind the lower left first molar toward the temporomandibular region and involving the greater part of the ramus, about the size of a lemon. There was no involvement of the soft tissue. The x-ray report was as follows: "There is a large multiloculated thin-walled cystic area of bone destruction involving the left mandible, beginning at the first molar and extending backward and upward into the coronoid process and ascending ramus. The coronoid process is completely destroyed and markedly expanded. The neck and articulations of the left mandible are normal. The appearance is that of adamantinoma of the left mandible." (Fig. 14.)

December 4, 1937, the patient was operated upon under general anesthesia. Ligation of the carotid artery was resorted to prior to removal of the tumor. First, an incision was made over the mucous membrane of the mandible, and a Gigli saw passed around the mandible at the left bicuspid region. The mandible was cut through and dissection was carried further back until the entire tumor was removed, including the condyle. Although the external carotid had been ligated, there was considerable bleeding, which made it necessary to pack the wound with sterile gauze. The external incision extended from the angle of the jaw to the side of the chin, but not to the lower lip. While the patient was under the anesthetic, wire hooks were made, utilizing the upper central incisors and the lower left bicuspid and cuspid teeth. These hooks were later used for the purpose of applying intermaxillary elastics.

The pathologic report stated that the specimen was a portion of the left side of the mandible including the ramus and was 5.5 cm. in length. (Fig. 15.) The horizontal portion measured 5.5 cm. in length. The tumor was situated in the center of the alveolar process and the ramus was a large, irregular, hard and partly osseous tumor-like swelling, partially fragmented and measuring 3.5 cm. across and 5 cm. in length. It had destroyed most of the adjacent mandible in which it lay. It apparently contained a number of multilocular cystlike cavities measuring up to 3 cm., also some hard areas measuring up to 1 cm. (adamantinoma). (December 4, 1939.)

The patient had rather a stormy convalescence, but made a good recovery. Ten months later, she reported for construction of a dental appliance, which she is now wearing with considerable comfort.

The appliance consisted of two dental plates connected by a bar, at the upper end

of which was a hinged joint. The fork at the lower end rested on a small bar incorporated in the lower plate. As the mouth opened, there was no disturbance of the lateral motions of the jaw. When the teeth were in contact, the bar forced the lower jaw into normal position. (Fig. 16.)

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SOLUTION OF PULP TISSUE BY CHEMICAL AGENTS

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THE elimination of necrotic pulp tissue from the root canal is important for the ultimate success of a root-canal operation. To attain this end, both mechanical and chemical means are employed. Among chemical agents used for this purpose may be mentioned sulfuric acid (Callahan[1]), sodium-potassium alloy (Schreier[2]), sodium dioxide (Kirk[3]), sodium methylate (Levene[4]), papain (Wilkinson[5]) and chlorinated soda solution (Walker[6]). Solutions of hydrochloric acid, sodium hydroxide and potassium hydroxide have also been used and advocated for disintegration or solution of pulp tissue. Of historical rather than practical interest is the use of maggots for cleansing the canal of necrotic tissue, as suggested by Dreher.[7]

The purpose of this study was to determine which of the agents already mentioned, or others believed to have a solvent action on tissue, is more effective. Sponer,[8] Blum[9] and Holst and Pedersen[10] undertook somewhat similar studies, limiting themselves to fewer chemical agents or including proprietary agents not known in this country.

METHOD

The method used by us was as follows: 1 cc. of the chemical to be examined was placed in a small test tube, such as those used for Wassermann tests. Freshly extracted teeth were split open and the pulps were removed with tweezers. When necessary, the pulps were trimmed so as to have the same amount of tissue exposed to the same amount of chemical solution throughout the tests. The pulp tissue was then placed in test tubes containing the chemicals. The tubes were identified by number only, the identity of the solutions being unknown to the one making the observations. From time to time, the code number identifying the solutions was changed. This method of blindfold testing eliminated any possibility of bias.

It should be mentioned here that

while every effort was made to have both the quality and quantity of pulp tissue alike in all series of tests, it was not always possible to detect calcific changes in the pulp tissue by microscopic examination. The somewhat variable results occasionally encountered may have been due to this fact.

The following chemicals were examined:

1. Chlorinated soda solution, double U.S.P., X strength. This aqueous solution, which has been recommended by Walker,[6] is made up of sodium hypochlorite and sodium chloride containing at least 5 per cent of available chlorine. It is dispensed as *liquor sodae chlorinatae*, U.S.P., X double strength.

2. Enzymol, which is used in general surgery for its solvent action upon necrotic tissue, and is said to contain gastric juice and proteolytic enzymes. Only the stock solution was used in these tests.

3. Galactonic lactone, a solvent of mucin, suggested by Levene[4] as a possible substitute for more caustic agents used in the root canal. A saturated aqueous solution was used.

4. Hydrochloric acid (30 per cent), which is primarily used for its destructive effect upon organic pulp tissue.

5. Papain, a 10 per cent solution in 0.001 normal hydrochloric acid, as suggested by Wilkinson.[5]

6. Potassium hydroxide, 20 per cent aqueous solution, as recommended by Holst and Pedersen.[10]

7. A saturated aqueous solution of sodium hydroxide. A weaker, 25 per cent, solution, as suggested by Abraham,[11] did not materially affect the results obtained with the saturated solution.

8. A 50 per cent solution of sulfuric acid as recommended by Callahan.[1]

9. Tendra, a proprietary made from the milky exudate of unripe *Carica papaya*, a tropical fruit. Tendra is said by the manufacturer to be a purified enzyme capable of digesting protein. A stock solution was used in these tests.

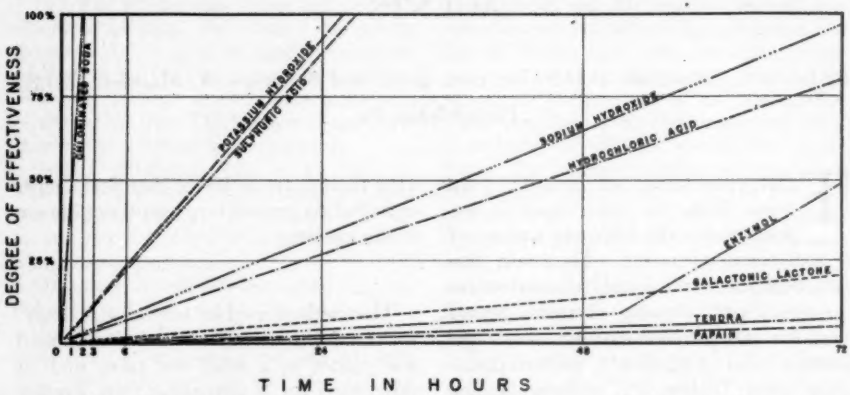

Chart showing degree of effectiveness of pulp tissue solvents. Observations of the degree of effectiveness (ordinate) were made after one, two, three, six, twenty-four, forty-eight and seventy-two hours (abscissa).

Sodium dioxide, sodium methylate and sodium-potassium alloy were omitted from the tests because of their instability in aqueous solutions.

No effort was made to determine by *in vivo* experiment the degree of irritation of living tissue from each of the chemical solutions studied, since all of the drugs mentioned, with the exception of galactonic lactone and tendra, have been used clinically in root canal work.

The test tubes containing the above-

mentioned chemicals and pulp tissue were placed in an incubator and kept between 37 and 40° C. Observations were made several times during the first hour, and after two, three, six, twenty-four, forty-eight and seventy-two hours. Tests were repeated at least fifteen times for the more promising chemical agents. When a chemical had no apparent effect on pulp tissue after three tests, it was dropped from further study.

RESULTS

From an examination of the data as plotted on the accompanying graph, it is evident that chlorinated soda solution (double strength U.S.P., X) was the most effective pulp tissue solvent. It was also the only chemical solution investigated that dissolved pulp tissue in less than two hours, occasionally effecting complete solution in less than twenty minutes. Chlorinated soda solution will deteriorate with age and should be kept in a cool place away from sunlight. A small amount (about 1 ounce) should be made up at a time and the remainder discarded after about two months because of deterioration.

There is apparently little choice between the effect of potassium hydroxide and that of sulfuric acid. Both dissolved pulp tissue in about twenty-four hours. Holst and Pedersen found that potassium hydroxide was more effective than sodium hydroxide for dissolving pulp tissue, and we were able to confirm this finding.

Sodium hydroxide was slightly more effective than hydrochloric acid, but neither dissolved pulp tissue in less than seventy-two hours.

Enzymol showed a sharp increase in effectiveness after forty-eight hours, probably because it acts best upon necrotic tissue and the pulp tissue had become disintegrated by that time. It was less effective, however, than the chemical solutions already mentioned.

Galactonic lactone, tendra and papain were found to be ineffective even after seventy-two hours.

SUMMARY

1. Under the conditions of *in vitro* tests described here, chlorinated soda (double U.S.P. strength) is an effective solvent of pulp tissue. It was found to dissolve the pulps of freshly extracted teeth in less than twenty-four hours; at times, in less than an hour.

2. A 20 per cent potassium hydroxide solution and 50 per cent sulfuric acid generally dissolved the pulp tissue within twenty-four hours.

3. Sodium hydroxide (25 per cent solution and saturated solution), hydrochloric acid (30 per cent) and enzymol (stock solution) generally, but not always, effected solution within seventy-two hours.

4. Galactonic lactone, papain and tendra did not effect complete solution within seventy-two hours.

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RESTORATION OF MISSING TEETH IN ADOLESCENTS

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IT is appropriate that this paper be given at the last session of our meeting. In oral hygiene and children's dentistry, as practiced today, we should have to restore missing teeth in adolescents and adults only because: 1. The child had congenitally missing teeth or pathologic growths. 2. An accident, so frequent in childhood play, athletics and vehicular mishaps or collisions, had occurred. 3. The parent, child or dentist failed to do all that science and time have clearly demonstrated might have been done—and extraction became necessary.

Normally and naturally, we expect to find twenty-eight of the thirty-two adult teeth erupted and functioning in the mouth of an adolescent. It is well for all dentists to review constantly the calcification, eruption and completion of calcification tables and times of eruption of both deciduous and adult teeth. Many conditions are present to change and affect the eruption and calcification of teeth and a knowledge of them is always necessary to the dentist.

While we do not know or understand all the etiologic factors in dental caries, periodontal involvement or malocclusion in every case, we do know that we can prevent pulp complications and loss of teeth from periodontal lesions in a healthy, cooperative patient, provided he (a) is well-born, having a good health heritage; (b) has had adequate nourishment before birth and until adolescence; (c) has made early and systematic visits to the dental office beginning at about 2 years of age, and (d) has cooperated in home care, exercise and stimulation of the gums.

Prevention seems to be the paramount issue of the day, and we are learning that prevention must begin with the prospective grandparents. Instruction of the child in the formative, growing years of life is the best means to the much desired end of prevention as it concerns disease, ignorance and poverty. Viewed in a comprehensive manner, nearly all oral health services are preventive, in that we strive to arrest pathologic processes or developing deficiencies and disorders. Possibly, prevention is an ideal which runs all through dentistry and largely motivates the services in every phase of our profession's work. Prevention in dentistry may be defined as the efforts put forth to obtain and maintain normal development and physiologic function and to inhibit disease of the mouth and correlated parts.

As doctors of dental surgery, we have little power to cure. Cure is always in the realm of those laws which govern growth and development of the cells. When it is possible to remove an irritant or exciting cause of disease or to develop tissue tone and resistance, the body cells will of themselves tend to restore function and return to normal balance. Any procedure that has for its aim removal of the cause, not the effect, of dental disorders and disease is believed to be preventive. True prevention of dental disease is dependent on the absolute integrity of the whole body, but specifically on the enamel and gingiva. In its broadest concept, prevention is a matter of edu-

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cation and cooperation rather than of therapy and operative procedure.

Each age group presents specific problems, which arise as we attempt to maintain oral health. Specific prophylactic and hygienic measures must be utilized to meet these problems. Our attention must constantly be focused on preservation of the health of the oral cavity. We must consider critically (1) the development, nutrition and functioning of the body with special reference to the mouth and teeth; (2) the various and manifold services of the dentist, and (3) the environment, heritage and activities of the patient, to the end that both the teeth and the mouth may be conserved.

The mouth is subject to many deficiencies, disorders and diseases. Some of these abnormalities appear very early in life, but they are found at all ages. They arise from a lack of growth and development, infectious processes, neoplastic processes, injuries, degeneration and many other conditions. Some of these disorders appear to be local in origin and effect; others have important systemic relationships, in that they are either the result of systemic disturbances or they produce such disturbances.

The most common defects and diseases among mankind are those associated with the teeth. Dental disease, particularly periodontal lesions and caries, has been responsible up to the present time for the loss of most of the teeth of the majority of persons who have reached the age of 50 years. The high incidence of dental disease among children and the lack of early dental care are indictments against the dentist and public health worker.

The importance of the deciduous teeth is not sufficiently understood or appreciated. Toothache is still common among children, and many days are lost from school on account of it. The early loss of the first permanent molars is shown in all dental statistics. Extensive restorative work is in evidence in the mouths of adults. Some of this work has been done well, but a considerable portion of it seems to be imperfect and unsatisfactory. Achievements in the field of preventive dentistry are neither so striking nor so numerous as in preventive medicine. A complete health service by means of dental restorations is provided only when the mechanical procedures and biologic factors are properly coordinated by a well-informed dentist.

Today as never before, the members of our profession are leading all others in the healing arts in the ability to carry out beautiful, comfortable and pleasing artificial restorations. In this day of informed and proved preventive dental practice, teeth should be missing in adolescents for only two reasons: (1) congenital conditions and (2) accidents. We have learned to place appliances, replace teeth and restore function in harmony with growth and development without seriously impairing the remaining teeth, but our responsibility, obligation and true worth to the public are not one iota lessened because we have improved our methods and technic and have attained this practical position of usefulness. Scientific research and proved experimentation have brought our profession honor and respect, but filling, extracting and replacing teeth are not the goal our profession should eternally strive to reach.

In the beginning, the service dentistry offered was chiefly a means for the retention of loose teeth and for the artificial replacement of missing or lost teeth. The art was practiced principally to disguise disfigurement or disability. In the evolution of the profession, dental defects have been repaired and lost teeth replaced with increasing regard for the esthetic and functional aspects of dental reconstruction. Several centuries passed before correction of irregularities of the teeth, and until means of limiting the extension of decay for the conservation of defective teeth became common objectives in dental practice. Even then, health

service continued to be a subordinate purpose and was achieved in the main negatively, through the extraction of diseased teeth. "Progress is the law of the universe," and any one who will not bend his will to this law not only handicaps himself, but also robs those whom he should serve of their rightful part in all that is highest and best.

In recent decades, as has been suggested, there have been notable advances in the technical repair and remedial treatment of defective teeth and artificial replacement of lost or congenitally missing teeth. There has also been marked development of means for the preservation of dental function and of methods for the elimination of dental infection. Oral hygiene and the important work of our section have received increasing attention from both the public and our confrères. The advent and utilization of the x-rays in dental practice thirty years ago as an aid in the detection and diagnosis of hidden ailments of the supporting tissues and teeth; the general belief of the past two decades that infections of the teeth and component parts may cause serious disease in other parts of the body, and recent findings in chemistry, biology and allied subjects such as physiologic diets and balancing of glandular functions for normal nutrition and dentition have now made the development and application of means for the prevention of dental disorders and of their systemic sequelae the paramount duty of every member of the dental profession.

As the knowledge of a branch of dentistry increases, and procedures and principles known to be effective in the prevention or treatment of conditions seen in this field multiply, the responsibility of the practitioner grows. Why are most of our services still reparative or restorative? A truly professional man works unceasingly to eliminate the need for his profession. We have to replace missing teeth in the mouths of adolescents, but we should not have to replace as many as we do. Preventive dentistry constitutes less than 20 per cent of the average man's practice. Since operative and prosthetic procedures appeal to the patient as more valuable than preventive measures, we have possibly been better mechanics and salesmen than oral physicians and teachers.

The adolescent's mouth presents many perplexing problems to the dentist called upon to restore missing teeth. The root has not been completed and consequently the vertical dimension has not been dependably established. The pulp chambers of the adult teeth are large, and fixed bridgework cannot be attempted without grave consideration. The problems associated with growth processes, glandular imbalance and orthodontic needs are met at this age more than any other. The individual is growing up, emerging from childhood into adulthood, emotionally, physically and dentally a different person from what he has been, full of desires and visions, yet grossly misunderstood, and inexperienced.

When, for any reason, it becomes necessary to restore or replace missing teeth, we must remember that the mouth is a part of the body. It cannot be divided into specialties, nor can it be standardized or restored without allowance for normal growth and development. The type of restoration or replacement must usually be removable or fixed removable. It must be esthetically pleasing, comfortable, harmless to other teeth and tissue and designed to perform certain very definite services at this particular time. These restorations, in many cases, cannot restore true and full-mouth function. Certainly, they must not interfere with growth and the physiologic processes of daily living. At best, many of our replacements for adolescents are but space maintainers or space retainers, orthodontic appliances or temporary artificial restorations to help prevent serious future trouble or mutilation. More often than

not, when the need arises for the restoration of missing teeth in adolescents, orthodontic treatment is already badly needed or is in progress or must certainly be initiated at the time the dentist sees the patient, or in the future.

In cases of congenitally missing teeth, the spaces must be maintained or opened up by the use of space retainers or, better, orthodontic appliances. Then the matter of replacements must be considered, but not before. In cases of cleft-palate, harelip or cystic or tumor formation in which the teeth are seriously malalined or have been lost, the judgment and ingenuity of the orthodontist and the dentist are taxed. Those manifold anomalies of the oral cavity, such as submerged deciduous molars, supernumerary teeth and peg-shaped or malshaped teeth, offer a problem in the mouths of adolescents which must, in many instances, be considered as if there were missing teeth. The simpler and more easily made the appliance, the better.

If we are to serve all our patients, cost must be considered as well as patient cooperation. Some devices and appliances actually do the patient more harm than good, and, unless the child and mouth are studied critically as a whole for both present needs and future requirements, many times we would do better not to attempt restoration of missing teeth in the adolescent. The processes of growth and development should not be interfered with. The matter of doing a little bit now in order to have a better mouth condition later requires all the knowledge and experience of both the orthodontist and the general practitioner. Do not mind asking for consultation and assistance. Admit you do not know what is best when this is true. Do not promise too much in the way of a so-called perfect end-result, for we are but dentists, not magicians. Many times our patients think we can do things which we know we cannot do; and sometimes, they accuse us of doing things we did not do.

Individual teeth or units of from one to four teeth, spaced or together, may be soldered satisfactorily to a well-fitting passive lingual arch anchored in half-round lingual tubes of the first molar bands. Anchorage as well as orthodontic assistance may be increased as necessary. This replacement appliance, together with properly diagnosed, well-constructed functional space retainers, such as are made by Willett and improved upon by Brauer, or other appliances similarly planned and constructed, are always my first choice. I do not favor the carelessly designed vulcanite horseshoe type retainer, nor many of the so-called space retainers which do not stay put, retain space, improve the appearance or restore function. It seems paradoxical, but sometimes, in the case of missing teeth, it is better, simpler and more serviceable for the future for the patient to extract another tooth before beginning the actual replacement.

Orthodontics can and does assist in making many perplexing cases simpler. Malocclusion must be prevented, treated or improved before missing teeth are supplied. Systemic conditions of the body seriously affect, and manifest themselves in, the mouth. A child should, dentally as well as physically and morally, "be brought up" in the way he should go.

Then, the disposition, character and results of treatment, as well as the health, will not be penalized, obstructed or impaired. If missing teeth in adolescents are not replaced, if the resulting malocclusion is not treated and corrected, our profession has not done what it can and should to assist the patient to be healthy, happy and useful. Dentistry cannot always render defective or infected teeth healthy, but it can and does perform a most important service to the patient by intelligently supplying missing teeth for adolescents and adults when loss of teeth cannot be prevented or avoided.

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HEMORRHAGE: CAUSES AND MANAGEMENT

By Walter William Dalitsch, M.D., D.D.S., Chicago, Ill.

EXCESSIVE bleeding, following operations on the oral tissues, is not an uncommon occurrence. Such disturbances often assume a serious aspect and their control then presents an urgent problem.

Review of the literature reveals numerous reports of excessive hemorrhage, but these reports are often incomplete and mislabeled as dealing with hemophilia.[1]

Understanding and proper management of hemorrhage require an adequate knowledge of its etiology. Thorough physical and laboratory examinations, especially complete blood and platelet counts, coagulation time and bleeding time determinations, fragility tests, vitamin estimations, etc., are necessary for accurate diagnosis of the underlying cause of a hemorrhagic diathesis. As these procedures are not always available nor practicable for the dental practitioner, hospital and medical consultation are often required.

The conditions predisposing to hemorrhage may be classed as (1) systemic, which are usually under medical cooperation, and (2) local, usually traumatic in origin and requiring surgical management.

The conditions predisposing to hemorrhage are: systemic: anemia, avitaminosis, endocrine disturbances, hemophilia, hypertension, leukemia and purpura; local: capillary rhexis with oozing, tearing and cutting of smaller venules and arterioles and injury to larger vessels, veins or arteries.

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Read before the Section on Oral Surgery and Medical Relations, at the Seventy-Sixth Annual Midwinter Meeting of the Chicago Dental Society, February 14, 1940.

SYSTEMIC CONDITIONS

The anemia which is commonly associated with excessive bleeding is the pernicious form, when in an advanced stage, and the aplastic type. Management of the pernicious form requires the feeding of liver or liver extracts. In additional regulation of the diet, calcium administration and vitamin therapy are beneficial. Treatment of the aplastic form is of little benefit. Transfusions are palliative and temporarily control excessive bleeding.

Vitamin deficiencies responsible for prolonged bleeding are exemplified in scurvy by a deficiency of vitamin C, and in the type of hemorrhage associated with jaundice, in which there is a deficiency of vitamin K. Administration of these respective vitamins is uniformly effective in controlling the bleeding manifestations.

Vicarious menstruation may result in gingival or prolonged postextraction bleeding. Similar excessive bleeding may occur as a complication during a normal menstrual period. The gingivitis of pregnancy presents a similar problem. Management requires adequate ovarian hormone therapy, avoidance of dental manipulation during the menstrual period and the use of local measures, such as with styptics, coagulants and pressure packs and other forms of tamponade.

Hemophilia presents the most serious

forms of hemorrhage. The condition may become known to the dentist because (1) the hemophiliac is aware of his condition; (2) there is a hereditary history of excessive hemorrhage in other male members of the family, or (3), in true hemophilia, there is a previous history of bleeding, at the time of tooth eruption or shedding of deciduous teeth, or when the oral tissues are injured, and especially if dental extraction is attempted.

Treatment of bleeding in hemophilia[1]: Unnecessary dental manipulations should be avoided. Operations should be performed when the clotting time is lowest. Dental procedures should be carried on with a minimum amount of trauma.

Preparation of the patient with a transfusion of normal blood will promote clotting. Local applications of tissue extracts (cephalin, fibrogen, hemoplastin, gelatin), normal blood, styptics, coagulants, etc., to the site of bleeding may prove of some value.

A close fitting molded splint of vulcanite or modeling compound over the site of bleeding or extraction and fixed in place by wire ligatures to adjacent teeth will prevent disturbance of clot formation and will hold tissue exudates in contact with the bleeding tissue and thus favor the formation of a clot. This procedure has been termed a "hemorrhage arrester."[2]

Packing of sockets and suturing of bleeding margins are contraindicated and may be harmful. A tightly placed pack in the bleeding socket may dam back and divert the flow of blood into the submucous and infra-oral tissues, with resultant dangerous pressure on the trachea and esophagus.[3] Fatal asphyxia has been reported as following such packing.[4] If suturing is attempted in hemophiliacs, there will frequently be additional hemorrhage from the puncture wounds made by the needle.

An important means of obtaining quick help is the intramuscular injection of whole normal blood. Such blood does not require typing, and one should merely be assured that there is no luetic or other infection in the blood donor. Injection of from 40 to 80 cc. into the gluteal muscles will often prove of great benefit.

In the event that none of the foregoing procedures stop the bleeding, transfusion must be resorted to with blood from a donor whose type matches that of the recipient. The blood may be given by the indirect method after it has been citrated, or it may be given directly from donor to bleeder by the Scannell method. Birch is of the opinion that blood that has been stored in a blood bank is of little value in stopping hemophilic hemorrhage. One must always keep in mind that, as a last resort, a transfusion is the best therapy when other measures fail. It not only replaces the tissue that has been lost by hemorrhage, but also adds those substances that are required to promote clotting.

If it is deemed important that removal of teeth be undertaken in a person who is a known bleeder, the method of exfoliation by rubber band constriction may be used.[5, 6] This procedure provides a safe and comparatively bloodless method of removing teeth and has been used in severe cases of hemophilia with success.

In hypertension, bleeding from the oral tissues is not so common as from other regions, as, for instance, in epistaxis. When it can be determined that such bleeding is a result of hypertension, efforts to check it are usually contraindicated as a moderate hemorrhage may act very much like a therapeutic venesection. It may result in a temporary decrease in blood pressure and it may ward off cerebral hemorrhage and apoplexy.

Leukemia, either leukosis or lymphadenosis, may occur in acute or chronic forms. The acute forms may present as their first symptoms bleeding from the

oral tissues, usually a severe and persistent oozing which does not yield to local measures of control. They are often misdiagnosed when seen early, until glandular enlargement, splenic enlargement or hematologic studies reveal the correct cause.

The chronic forms of leukemia may not show much of a hemorrhagic diathesis until late in their course, when the disease has progressed to the point of cachexia with bone marrow exhaustion. They usually run an acute violent course, and little can be done to control the hemorrhagic tendency. Transfusion and roentgenotherapy may prove of temporary benefit. Thorough removal of all blood accumulations about the teeth and the use of a hydrogen peroxide mouthwash (a 33 per cent solution of 3 per cent hydrogen peroxide) are of considerable benefit, in that they prevent growth of bacteria and a complicating ulceromembranous stomatitis. Jaffe has frequently stressed the importance of this procedure.[7]

Purpura, a frequent cause of bleeding, may be primary or secondary. In the primary type, frequently associated with a lack of blood platelets, the true cause is unknown, but many cases respond favorably to removal of the spleen. In secondary forms, there are various factors. A nutritional or vitamin imbalance, as seen in scurvy, is a not infrequent cause. Toxins, either bacterial or chemical, may produce the secondary type. Infections, either acute contagious or low-grade chronic types, may produce purpura. Low-grade chronic Vincent's stomatitis has been observed to bear relationship to severe purpura.[7] Other cases of purpura may be a result of an allergic manifestation.

Patients with purpura are likely to present the initial manifestations of bleeding in the oral tissues. There may be pinpoint petechiae in the mucous membranes of the soft palate and cheek, or larger spots of ecchymosis. Similar petechiae and ecchymosis may occur in the skin. The bleeding time is increased, although the coagulation time may be normal. There is increased capillary fragility, so that a tourniquet applied to the arm will produce petechiae below the point of constriction. Frequently, examination of the blood will disclose a decrease in the number of blood platelets.

Agranulocytosis, the condition in which there is an absence of granulocytes, the granular white blood cells, may also show a marked diminution of blood platelets, resulting in bleeding manifestations, and may be grouped with purpura as far as management of oral hemorrhage is concerned.

Management of purpura: If any of the conditions mentioned can be identified as a cause, they should be corrected. It is of great value to remove accumulations of blood from about the teeth, as they act as good culture media for the growth of bacteria, especially Vincent's organisms. As in the management of leukemia, a peroxide mouthwash is of value in removing bloody accumulations and as an antiseptic.

Local applications of styptics (Monsel's solution) should be tried. Administration of coagulants (various tissue extract preparations) and pressure with a gauze pack over the bleeding site should be tried. A tamponade with modeling compound or a molded vulcanite splint will aid, and intramuscular injections of whole blood and transfusions will produce best results in severe and otherwise uncontrollable forms of purpura.

LOCAL CONDITIONS

Capillary rhexis, resulting in persistent oozing without any local point of gushing, often follows trauma, such as tooth extraction and injuries from dental manipulations. It may occur more readily in inflamed and congested tissues, as in gingivitis, stomatitis and vascular benign and malignant growths. Management of

this type of bleeding should consist of removing any loose clots and accumulations of blood or débris, followed by the application of pressure with plain sterile gauze or iodoform gauze directly to the site of oozing. Having the patient bite against the bit of gauze sufficiently to maintain continued pressure is an effective procedure. Softened modeling compound may be applied to the site of the oozing (for example, in a tooth socket) and chilled and fixed in place with ligatures to the adjoining teeth. Local applications of medicaments, such as epinephrine and Monsel's solution, are indicated.

Venous and arterial bleeding occurs where there are considerable injury and laceration, and the bleeding appears to come from the deeper tissues, gushing or spurting. One or more large sutures should be placed around and under the bleeding area. These will usually maintain pressure against and occlude smaller veins or arterioles until firm clotting results. If the depth of the wound is sufficiently accessible and can be adequately inspected, the torn vessel may be clamped with artery forceps and ligated.

If the foregoing procedures fail to stop the loss of blood, regional ligation may be necessary. For example, the lingual or the palatal artery may be exposed and tied off, or it even may be necessary to ligate the external carotid as a life-saving measure.

General measures to be used in cases of hemorrhage should include: (1) restoration of the blood volume by intravenous administration of saline, glucose or acacia solutions, and (2) replacement of lost blood by intramuscular injection of whole blood, not necessarily of a similar type, or by intravenous injection of whole blood, which may be given by the direct method, injection of whole blood from a suitable donor who has been typed and matched; by the indirect method, first treating the blood with sodium citrate to prevent coagulation, or by the administration of stored or canned blood from a "blood bank."

Shock should be treated with stimulants, warmth, morphine and fluids.

SUMMARY

In a consideration of the causes and management of hemorrhage, systemic conditions, usually requiring medical management, such as avitaminosis, purpura, hemophilia, endocrine disturbances, leukemia, anemia and hypertension, must be included. Local conditions, usually traumatic in origin, require surgical management. Adequate treatment of hemorrhage requires a thorough knowledge of the cause, as well as of the general and local methods of control.

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CARBOHYDRATE DEGRADATION BY MOUTH ORGANISMS. III. L. ACIDOPHILUS

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THE etiology of dental caries has been the subject of numerous investigations. Miller[1] and Black[2] proposed the chemicoparasitic theory, postulating the dissolution of tooth enamel by organic acids. With certain modifications, this theory is accepted by most research workers. The mechanism by which organic acids are formed from carbohydrate material clinging to the teeth was first suggested by Fosdick and Hansen,[3] who adapted the Meyerhof[4] scheme of carbohydrate degradation by muscle and bacterial enzymes to the acid formation by mouth organisms.

Fosdick[5] later showed that the intermediate products in degradation could be isolated from fermentation mixtures of saliva, glucose and tooth enamel. This indicated that the fermentation reactions take place in the mouth during the formation of the acids that dissolve the enamel. The acid formation can also be demonstrated by pH measurements of plaque material and carious material, as was performed by Stephan,[6] who showed that the pH of these materials were frequently much lower than that of the saliva. Miller and Muntz[7] have shown that lactic acid is present in appreciable quantities in the material taken from carious lesions.

Bunting and Jay,[8] from their investigations of the environmental factors in dental caries, have reached the conclusion that *Lactobacillus acidophilus* is the most consistent organism associated with dental caries. Anderson[9] found that dental caries could best be correlated with certain strains of streptococci. Fosdick and Hansen[3, 10] suggested that yeast played an important rôle in dental caries. It was noted that the yeast organisms caused the solution of a larger amount of enamel, under their experimental conditions, than did any other organism, while *L. acidophilus* produced no effect. However, when a mixture of yeast and *L. acidophilus* was used, the amount of decalcification was doubled, indicating a symbiosis of the two organisms in the acid formation by degradation of carbohydrates. The fact that *L. acidophilus* increased the acid formation when grown with yeast, and produced very little acid when grown alone, indicated to them that in the chain of reactions involved in acid fermentation, there were certain steps that were more rapid than others, and the rates of reaction of the different steps varied with the type of organism present. This may mean an alteration in the content of the enzyme system.

The degradation of carbohydrates has been shown to follow a series or cycle of reactions in the production of the acids responsible for dissolution of tooth enamel. These reactions involve the production of hexose monophosphoric acid, hexose diphosphoric acid, phosphoglyceric acid, pyruvic acid and lactic acid. Muscle and bacterial enzymatic transformation of carbohydrates is thought to follow the same general scheme up to and including the production of pyruvic acid. At this point, the paths diverge, the end-products varying with the experimental conditions and type of organism used.

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Fosdick and Wessinger[11] have studied quantitatively the ability of yeast "A" *(Saccharomyces cerevisiae)* to promote each of the reactions involved in the degradation of glucose to lactic acid. The results of a similar study with *Lactobacillus acidophilus* will be discussed in this paper. It is expected that the ability of other mouth organisms to catalyze the degradation of carbohydrates will be investigated on the same basis by future workers.

growing the organism in large quantities under semi-anaerobic conditions. Known weights of the dried organisms were allowed to act separately on glucose and the various intermediates. The reaction mixture was analyzed for the succeeding compound. The investigation was thus placed on a quantitative basis.

The results of the phosphorylation reaction, carried out as previously described,[11] are shown in Table 1. It will be noted that a twenty-four-hour period

TABLE 1—PHOSPHORYLATION OF GLUCOSE BY ACIDOPHILUS AT VARIOUS pH LEVELS (TWENTY-FOUR HOURS)*

pH	5.45		6.60		8.45	
Trial	I	II	I	II	I	II
pH after	5.08	5.10	5.66	5.70	6.02	6.00
Glucose before incubation	6290	6170	6480	7960	6900	6720
Reducing substances after incubation (as glucose)	6200	6090	5400	7120	4170	4780
Reducing substances lost (as glucose)	90	80	1080	840	2730	1940
Free phosphorus before	637	643	707	532	660	682
Free phosphorus after	623	643	582	410	425	505
Phosphorus esterified	14	0	125	122	235	177
Phosphorus esterified as monophosphate	0	0	44	45	47	58
Hexosemonophosphate formed	0	0	369	377	394	486
Phosphorus esterified as diphosphate	14	0	81	77	188	119
Hexosediphosphate formed	76.8	0	444	422	483	652
Per cent phosphorus esterified	2.2%†	0	17.7%	29.9%	35.6%	25.9%
Per cent esterified phosphorus as monophosphate	0	0	35.0%	36.8%	20.1%	32.7%
Per cent esterified phosphorus as diphosphate	100%	0	65.0%	63.2%	79.9%	67.3%

*Concentration in milligrams per hundred cubic centimeters.
†Within limits of experimental error.

EXPERIMENTAL PROCEDURE AND RESULTS

The experimental conditions used in this study are quite similar to those used with yeast,[11] with minor changes that will be reported later in the text.

The organism used in this investigation, *L. acidophilus,* was isolated from human saliva and tooth scrapings. A pure culture of the organism was grown on 1 per cent dextrose-tomato-peptone-agar. Since it was found that *L. acidophilus* grew more abundantly if a part of the air in the bottles used was replaced by an inert gas, a system was devised for

of incubation was found necessary, since little or no phosphorylation occurred in four hours.

The production of phosphoglyceric acid by *L. acidophilus,* as shown by the recovery of the barium salt, is shown in Table 2.

The results of the degradation of phosphoglyceric acid to pyruvic acid by *L. acidophilus* is shown in Table 3. A slight change was made in the concentration of the phosphoglyceric acid in the substrate used, but the results are comparable to those with yeast, if the analytic values

for *L. acidophilus* are multiplied by the factor 1.4.

The reductase activity of *L. acidophilus*, as shown by the reduction of pyruvic acid to lactic acid, is presented in Table 4. It has been found in the case of yeast[12] that a hydrogen donor found in sterile human saliva was necessary for this step. However, it was found that *L. acidophilus* could catalyze this reaction in the absence of saliva. The experimental procedure was therefore altered in this study by the omission of the saliva from the reaction mixture. Also, a twenty-four-hour period of incubation was used rather than the four-hour period as in the case of yeast.

TABLE 2.—PRODUCTION OF PHOSPHOGLYCERIC ACID BY L. ACIDOPHILUS (TWENTY-FOUR HOURS)

pH	Trial	Yield of Barium Phosphoglycerate	
		Mg./100 cc.	Mm./l
5.40	I	83	2.59
5.35	II	87	2.71
6.60	I	160	4.98
6.60	II	123	3.83
8.54	I	83	2.59
8.54	II	76	2.37

TABLE 3.—ACTION OF L. ACIDOPHILUS ON PHOSPHOGLYCERIC ACID (TWENTY-FOUR HOURS)

pH	Trial	pH After	Pyruvic Acid Formed Mg./100 Cc.	Acetaldehyde* Formed Mg./100 Cc.	Phosphoric Acid Formed Mg./100 Cc.
5.6	I	5.45	6.2	10.1	78.3
	II	5.43	4.6	11.2	86.2
6.8	I	5.83	21.3	11.4	32.9
	II	5.93	15.4	12.6	38.3
8.3	I	6.05	32.5	14.9	35.7
	II	5.90	31.5	7.9	49.0
	III	6.02	26.6	7.3	40.5

*Assuming all the material insoluble in 5 per cent sodium carbonate solution to be the 2,4-dinitrohydrazone of acetaldehyde.

DISCUSSION AND CONCLUSIONS

It has been demonstrated that *Lactobacillus acidophilus* contains the necessary enzyme systems for the transformation of glucose through the various intermediates that have been shown for muscle enzymatic degradation and yeast enzymatic fermentation. However, it must be noted that the ability of the enzymes of *L. acidophilus* to bring about the various steps in this degradation varies markedly from that of yeast.

In the first reaction, glucose is phosphorylated by *L. acidophilus* very slowly, if one compares the rate with that of yeast. Approximately, the same amount of glucose is phosphorylated in four hours by yeast as in twenty-four hours by *L. acidophilus*. It will be recalled that the phosphorylation by *L. acidophilus* in the four-hour interval was negligible. Hence, an enormous difference in the rate of

phosphorylation or their phosphatase content is shown. It will also be observed that the amount of glucose phosphorylated is greater at the higher pH levels. Most of the esterified phosphorus appears in the hexosediphosphate, only a slight amount being present in the monophosphate. This same relationship between the amounts of the two hexosephosphates is also observed in the case of yeast. Much of the glucose lost during the reaction was not recovered as either of the hexosephosphates, an indication that the reaction had partially progressed beyond this stage in the degradation.

In the second step, the hexosediphosphate divides into two parts, and these split products react to form 3-phosphoglyceric acid. It was found that *L. acidophilus* was able to catalyze this reaction and that the yield of 3-phosphoglyceric acid (as the barium salt) was greatest at pH 6.6. A greater reactivity was also noted at this pH level in the case of yeast. However, the yield in the case of *L. acidophilus* was only one-third to one-fourth that of yeast at this pH. Here again, as in the case of the phosphorylation of glucose, *L. acidophilus* is found to be less active than yeast.

The next step in degradation is the conversion of 3-phosphoglyceric acid to pyruvic and phosphoric acids. *L. acidophilus* was able to catalyze this reaction with about the same effectiveness as yeast, if one takes into consideration the differences of concentrations of the phosphoglyceric acid in the substrates of the two experiments (lower in the case of *L. acidophilus)*. The accompanying decarboxylation of the pyruvic acid to acetaldehyde apparently takes place with the same degree of effectiveness with either organism. The increases in phosphoric acid concentration in the two cases are not similar. The phosphoric acid output with yeast increases with the increased production of pyruvic acid, which is in accord with theoretical expectations. The results in regard to the phosphoric acid liberation by *L. acidophilus* are not in accord with theoretical expectations, and it is therefore suggested that some side reaction must utilize a portion of the phosphoric acid as it was being liberated, at least in the higher two pH's. The liberation of greater than equimolecular amounts of phosphoric acid occurred at the lowest pH.

The final reaction studied was the conversion of pyruvic acid in the presence of tooth enamel. The reductase activity of *L. acidophilus* was shown to be relatively high. It was found that approximately

TABLE 4.—ACTION OF L. ACIDOPHILUS ON PYRUVIC ACID* (TWENTY-FOUR HOURS)†

	With Hydrogen Donor			With Phosphoglycerol			With Hexosediphosphate		
pH before	5.4	6.7	8.7	5.4	6.6	8.7	5.4	6.6	8.7
pH after	6.7	6.7	6.9	6.8	6.6	6.7	6.9	6.7	6.8
Pyruvic acid before	1404	1404	1404	1404	1404	1404	1404	1404	1404
Pyruvic acid after	191	89	188	193	143	156	105	92	54
Pyruvic acid lost	1213	1315	1216	1211	1261	1248	1299	1312	1350
Lactic acid formed	315	612	414	261	369	306	413	638	567
Acetaldehyde formed	429	358	284	486	412	375	315	286	248
Pyruvic acid decomposed	86%	94%	89%	86%	90%	89%	86%	94%	96%
Decomposed pyruvic converted to lactic acid	25%	45%	33%	21%	28%	24%	33%	47%	38%

*Average of duplicate analyses.
†Concentration in milligrams per hundred cubic centimeters.

90 per cent of the pyruvic acid was decomposed under the conditions of the experiment and that 21 to 47 per cent of the decomposed pyruvic acid was converted to lactic acid. Decarboxylation of the pyruvic acid was quite prominent in the results. A portion of the decomposed pyruvic acid remained unaccounted for, owing presumably to further reaction of the intermediates, lactic acid and acetaldehyde. The addition of phosphoglycerol or hexosediphosphate did not seem to alter the reaction. Presumably, some hydrogen donor must have been formed, or some reaction, such as acetaldehyde to acetic acid, must have accompanied the reduction of the pyruvic acid, since one would expect the presence of a hydrogen donor to be necessary in this reaction.

Yeast and *L. acidophilus* would seem to have similar reductase activity, as shown by Fosdick, Hansen and Wessinger,[12] but their comparison was based on experiments carried out in the presence of sterile human saliva. When yeast is allowed to act on a pyruvic acid substrate for twenty-four hours, in the absence of human saliva, no reduction of the pyruvic acid occurs. In the study of the reductase activity of *L. acidophilus* it was found that the hydrogen donor in saliva was not necessary for the pyruvic acid to lactic acid step. This points to a difference in reductase ability, in that *L. acidophilus* can catalyze this reaction in some circumstances in which yeast is inactive.

It might not be amiss to point out that yeast grows much more rapidly than *L. acidophilus*. This might account for the greater enzyme content of the yeast, since it would require greater enzymatic power in its own metabolism.

Although the apparent symbiotic relationship between yeast "A" and *Lactobacillus acidophilus* has been mentioned, its importance in respect to dental caries has not been discussed. Previous investigators[3] have shown that, when the two organisms are present, acid formation increases markedly above that produced by either organism separately. For example, when yeast was added to a mixture of saliva, glucose and powdered tooth enamel, 22 mg. of calcium per hundred cubic centimeters was dissolved in eighteen hours. When *L. acidophilus* was added to a similar mixture, only 4 mg. of calcium per hundred cubic centimeters was dissolved under the same conditions. When a mixture of yeast and *L. acidophilus* was used, an average decalcification of 45 mg. calcium per hundred cubic centimeters was shown. There are undoubtedly other symbiotic relationships among the mouth organisms, although not many of the possibilities have been explored.[10] The symbiosis of yeast and *L. acidophilus* could be explained on the basis of their ability to catalyze each step in glucose degradation. The phosphorylation of glucose must be almost entirely due to the presence of yeast. Since *L. acidophilus* could not initiate this step rapidly, the formation of the decalcifying acids, occurring later in the degradation, was delayed; and hence only 4 mg. of calcium per hundred cubic centimeters was dissolved. Hence, if the phosphorylation of glucose by yeast was rapid enough not to interfere with later steps in degradation, one would expect a greater yield of the decalcifying acids when the two organisms were used together, provided the greater ease by which pyruvic acid is reduced under the influence of *L. acidophilus* is significant. It is entirely possible, however, that an explanation which has not been demonstrated by these experiments may be necessary, as the differences among all the reactions, with the exception of the first, may not be sufficiently great to explain the much greater acid production when a mixture of the two organisms is used.

The symbiotic relationship of the two organisms may perhaps be explained on the basis of the phosphorylation reaction

and the reductase reaction. Since *L. acidophilus* has shown unusual activity in the transformation of pyruvic to lactic acid, the conditions for reduction by yeast, although adverse, might still be favorable toward reduction by *L. acidophilus.* Hence, the phosphorylation of glucose by yeast; the joint production of phosphoglyceric acid and the hydrolysis of phosphoglyceric acid jointly by both organisms, and the reduction of pyruvic acid to lactic acid by the especially active *L. acidophilus* might be the form of the chain of reactions for production of acids carried out jointly by these organisms in glucose degradation.

The expression "decalcifying acids" has been used to call attention to the fact that it is believed other organic acids besides lactic acid are present in tooth-decalcifying processes. Since the ionization constants of two acids occurring in the Meyerhof scheme earlier than lactic acid are greater than the ionization constant of lactic acid, it will be apparent, assuming that the Meyerhof scheme is correct, that these acids must also play a rôle in tooth decalcification. Phosphoglyceric acid, the ionization constant of which is 3.8×10^{-3}, and pyruvic acid, the ionization constant of which is 5.9×10^{-3}, are the two acids referred to above. They are both stronger than lactic acid, whose ionization constant is 1.38×10^{-4}. Phosphoglyceric and pyruvic acids have not yet been isolated in carious material, presumably owing to their short life and an inability to show their presence in the very small quantities present, by existing micromethods.

By continuing the investigation of the ability of different organisms to catalyze the various steps in carbohydrate degradation, such as have been carried out for yeast and *L. acidophilus,* it is hoped that predictions can be made as to the most effective organism or combination of organisms in acid formation. The first step could readily be carried out by the action of the yeast; the fourth step, by the combined action of yeast and *L. acidophilus.* These two steps are accomplished with great rapidity, but the second and third steps are catalyzed at moderate rates. It is predicted that other organisms will be found that can catalyze the second and third steps more effectively than either yeast or acidophilus. The possibility of finding a third or a fourth organism, effective for these two steps, should not be overlooked, since its presence with yeast and *L. acidophilus* would undoubtedly increase the rate of tooth decalcification.

SUMMARY

1. *L. acidophilus* is able to catalyze the various steps in carbohydrate degradation.

2. The various steps of the degradation can take place at widely varied rates in the case of *L. acidophilus.*

3. The catalytic abilities of yeast and *L. acidophilus* have been compared.

4. There is a symbiotic relationship between yeast and *L. acidophilus.*

5. On the basis of theoretical speculation, it is suggested that the presence of other organisms, in conjunction with yeast and *L. acidophilus,* may augment the rate of decalcification of tooth enamel.

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OBTAINING VERTICAL DIMENSION IN EDENTULOUS CASES

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VERTICAL relation, sometimes called vertical dimension, is a term used in referring to the nose and chin relationship that is affected by the distance between the jaws. The correct nose and chin relationship is established by the natural or artificial teeth in centric occlusion, or by centric relation when the baseplates are in position.

Vertical relation can be better understood and obtained clinically if one understands the rest position of the mandible, which may be defined as that position in which the mandible is involuntarily suspended by the muscles of mastication and the depressor muscles, with teeth apart. In other words, the jaws are separated by the minimum amount of muscular contraction sufficient to overcome gravity. This position prevails all the time, and it makes no difference whether the patient is edentulous or not. It is an anatomic and physiologic arrangement.

Nature has designed this rest position with the minimum amount of muscular contraction to give time for restoration of muscle energy, and to rebuild the broken down parts used during the process of talking, chewing and smiling, which tear down the tissues.

The rest position may be assumed voluntarily and is constantly assumed subconsciously. We have observed that when our patients are told to place the jaw "in the rest or relaxed position" or "where it feels most comfortable," they immediately find two positions, a low position and one a little higher toward the maxillae. During walking or ascending or descending steps, the jaw moves upward and downward in the range between high and low rest positions. Incidentally, the jaw is considered relaxed.

The relaxed jaw may be the victim of unsuspected force, resulting in fracture of the mandible, the maxillae or both. In order to prevent such damage, the depressor muscles and the muscles of mastication are called on as a defense reflex mechanism. The operation of this mechanism is similar to the work of shock absorbers. If, however, force is applied too suddenly for the reflexes to act, damage occurs to mandible or maxillae.

Many patients with natural teeth or artificial dentures have complained that they did not know where to hold the lower jaw. They also have said that if they closed the jaw until the teeth touched, within a few minutes the muscles and teeth became tired. The treatment of such cases lies in the explanation of the rest position to the patient.

CENTRIC OCCLUSION AND CENTRIC RELATION OF MANDIBLE TO MAXILLAE

Successful artificial denture construc-

tion depends primarily on determining centric position. Centric relation is that position of the mandible in its relation to the maxillae wherein both condyles are in a comfortable retruded position in the glenoid fossae, from which functional movements can be made. In this position, the muscles of mastication attached to the mandible are capable of exerting their maximum crushing force. To balance these muscular forces, it is necessary to locate the focusing point of greatest muscular exertion of the muscles of mastication attached to the mandible. This point is located somewhere on a plane equidistant on the ridges between the median line and in the region of the first permanent molars.

Centric occlusion is that position of the mandible in its relation to the maxillae wherein the functional cusp planes of the teeth are in maximum contact. Thus, we find centric relation to be a fixed, positional relation, while centric occlusion becomes a constantly changing one, influenced by age, abrasion, extraction and habit.

In the construction of full dentures, in cases in which opposing cuspal relations have been lost, centric relation must be recorded before it is possible to establish centric occlusion. Therefore, centric relation indirectly becomes a tooth relation only after the teeth have been arranged in accordance with the recorded centric jaw relation. This statement implies that centric relation and centric occlusion must be in harmony.

To successfully register the centric relationship of the jaws, some understanding of the functional mechanics of the human jaws is required. As first recognized by Dr. Bonwill, the mandible is approximately an equilateral triangle, the apices being located at the heads of the condyles and the symphysis.

Let us visualize the mandible as an inverted stool, the heads of the condyles being two of the legs, and the teeth, when properly occluded, the third leg. As long as the teeth function on a plane that is in harmony with mandibular movement resulting from muscular exertion, balance is maintained. This plane of tooth function, known as the functional curve or curve of Spee, is individual to all cases. Remove the teeth and you have lost the third leg of the stool. Success can result only when the lost teeth have again been restored mechanically, to function in harmony with the mandibular movement produced by muscular exertion, with the teeth maintaining muscular balance. If the plane of the artificial teeth is the same as the occlusal plane of the lost natural teeth, any mandibular motion that is the result of muscular exertion will be fundamentally the same as that produced when the natural teeth were present in the mouth.

When, in the construction of dentures, this center has been changed downward, upward, forward or laterally from its former position as regards the natural teeth, the anatomic and physiologic arrangements are disorganized and efficiency is greatly impaired. It then becomes eccentric.

M. E. Niswonger, after a great deal of research, came to the conclusion that the tactile muscle sense of centric occlusion remains after the extraction of the upper or lower teeth. The term "tactile muscle sense of centric occlusion" is explained as follows: When the natural teeth come into centric occlusion, reflexes stimulate the masticatory muscles until their strength is dissipated or scattered, while another reflex stimulates the external pterygoids to action in separating the teeth from centric occlusion and starting the opening movement, and another reflex stimulates the depressor muscles to action to complete the opening action of the mandible. These reflexes also occur in crushing a hard bolus of food when the teeth are not in centric occlusion.[1]

In order to study the reflex mechanism that stops and starts the opening action of the mandible before the teeth are in centric occlusion, one may bite into a piece of hard candy, whereupon it becomes evident that the reflex action causes the mandible to stop and start the opening action long before the teeth are closed, thereby preventing traumatization of hard and soft tissues.

These reflexes remain after the extraction of all the upper or all the lower teeth, or both. If these reflexes did not remain after extraction, patients wearing artificial dentures could never open their mouths. It is at centric occlusion that the tactile, triggerlike action of the teeth sets up the defense reflexes ending the upward movement of the mandible. Likewise, the triggerlike action will set up these reflexes at centric relation upon the hard occlusal rims of the impression tray or well-fitting baseplates. In the edentulous, it is through these reflexes that centric relation is easily established and can be used in taking functional impressions.

In the act of swallowing, the mandible travels from rest position to centric occlusion and back again. When centric occlusion is reached in the act of swallowing, the lower teeth are held securely in contact against the upper teeth with a minimum amount of pressure. This amount is sufficient, however, for those muscles of deglutition that are attached to the mandible to act, making the swallowing action easy and effective. It is true that one can swallow without using centric occlusion, but the act is strained and forced.

In order to study the distance that the mandible travels from rest position to centric relation, an instrument known as a jaw relator was designed by Dr. Niswonger. This aided him in establishing the normal distance between the jaws from rest position to centric relation in full upper and lower dentures.

Thus in measuring this distance in 200 patients all with a complement of natural teeth, four-thirty-seconds inch was established in 87 per cent of cases, and 13 per cent had a variation of not less than one-thirty-second inch and not more than eleven-thirty-seconds inch. . . .

It is not the intention to convey the impression that greater variations may not exist because we have not found variations from rest position to centric relation in the region of the upper lip and chin of not more than eleven-thirty-seconds inch nor less than one-thirty-second inch in adult jaws with natural teeth in position. If the individual measurement cannot be obtained before extraction, that which was found in 87 per cent of the cases examined, four-thirty-seconds inch, or the tactile muscle sense, must be recognized, and we may say that this is Nature's plan and specification for the centric relation to the rest position of the mandible, which we now are able to control and use in restorative dentistry.[2]

Unless we make use of the principle of the one-eighth inch, the space that normally exists between the occlusal surfaces of the natural teeth when the jaw is in rest position cannot be obtained in occlusal and incisal reconstruction cases, nor in artificial dentures.

The problem which confronts us now is as follows: With a complement of natural teeth with extremely worn occlusal surfaces and incisor edges, does this space of one-eighth inch between rest position and centric relation remain constant as wear increases? The amount of tooth structure worn occlusally and incisally from both upper and lower teeth is five thirty-seconds inch (approximately 4 mm.), and therefore centric relation is moved closer to the maxilla. If so, does the rest position move closer to the maxillae in the ratio of this five thirty-seconds inch wear? Dr. Niswonger states that in making measurements in 200 cases with worn natural teeth, he found in 83 per cent of cases the one-eighth inch measurement. In none was it less than one thirty-second inch or more than seven thirty-seconds. Apparently, as the teeth were slowly wearing

down, Nature made the necessary changes in the bone and soft tissues in order to maintain the space of four thirty-seconds inch between rest position and centric relation, as had been proved with skulls whose teeth were flattened and worn, showing flattened glenoid cavities evidencing such changes of the rest position upward toward the maxillae.

We may also observe while chewing that the mandible moves from centric occlusion vertically and bodily to rest position. From rest position, the mandible moves downward and outward until the bolus of food is engaged between the occlusal surfaces, and then upward and inward toward and into centric occlusion, which proves that there is no lateral influence in mandibular movement until after the mandible reaches rest position from centric occlusion. Nature has so arranged the mechanism of mastication that after the bolus of food has been fluidized, the natural teeth, when they meet in what is called centric occlusion in mastication and other movements of the mandible, muscles, ligaments and joints, are in perfect coordination at the end of the upward stroke of the mandible. It is at this place that the tactile triggerlike action of the teeth sets off the defense reflexes ending the upward movement of the mandible. This causes the masticatory muscle power to be scattered and the external pterygoids and the depressor muscles to open the jaw, so that injury through traumatizing both hard and soft tissues is reduced.

Apparently, it is Nature's scheme not to use forced centric occlusion during the act of mastication and swallowing and in this triggerlike action. No doubt, forced centric occlusion if exercised habitually would cause traumatization of the tissues.

Forced centric occlusion may be understood to be present when the maximum power, voluntarily exerted by the muscles of mastication, forces the natural teeth into centric occlusion with or without the presence of food. Yet, during mastication, the natural teeth are not at any time in forced centric occlusion even if the bolus of food is as small as a shredded wheat fiber or as thin as a lettuce leaf.

From experience, we know that when an inlay or any other kind of prosthesis is a little too high, or if one natural tooth is unbalanced, removal of the high points reduces the traumatized tissue area. The opening of the bite at centric occlusion in the small amount of the filling is so significant that it destroys the synchronization of the original centric occlusion. Apparently, it is not so much the unbalanced occlusion, or the high filling, as it is the undissipated muscle power that causes traumatization before the teeth come into original centric occlusion.

It is also important to emphasize how muscle power can be relieved of its force and strength before the teeth come into centric occlusion. A good example of how this power is released is found in the familiar case of the grain of sand caught between the teeth. The grain may be so small that the human eye can scarcely detect it, but the jaw will open before it reaches centric occlusion. The same applies to crushing a cherry seed with the teeth. The jaws open before we are aware of it, and long before the teeth have closed, and thereby traumatization of the tissues is prevented.

Another of Nature's greatest handiworks is manifested in the very thing that we are considering now; namely, scattered or dissipated muscle power at centric occlusion with the natural teeth. This highly specialized coordination of muscles and teeth is considered at length in order to introduce a method of establishing vertical relation in the construction of full dentures. The method is based upon the belief that the tactile muscle sense of centric occlusion exists after extraction of the teeth.

APPLICATION OF REST POSITION AND CENTRIC RELATION TO EDENTULOUS CASES TO OBTAIN VERTICAL DIMENSION

After accepting the principle that there is a definite rest position and a highly specialized centric relation, it seems logical to use these two in the construction of artificial dentures. The procedure of using the patient's tactile muscle sense of centric occlusion is as follows: The edentulous patient is placed in the chair in an erect position and told to place the jaw "where it feels most comfortable"; that is, to relax or to swallow. After swallowing, when the jaw returns to rest position, the patient is told to close the jaws until he feels that he would be touching or clinching his back teeth. (Patients understand the meaning of clinching the teeth, but not of assuming centric relation.) He is told to repeat several times placing the jaw in these two positions; i.e., rest position and centric relation. After the patient has become acquainted with this procedure, occlusal rims are built up with compound or hard wax on vulcanite baseplates so that they are in even contact throughout while the jaw is in rest position. The occlusal surface of the lower rim is softened with a blow torch. Softening the compound is very important for if it is softened insufficiently (too hard), or oversoftened, failure results, as it interferes with the normal reflexes that were associated with the natural teeth in centric occlusion. The baseplates are then inserted in the mouth, and the patient is told to imagine that he has all his natural teeth and to chew into the softened compound until he thinks his natural back teeth would be touching or until he can imagine clinching his back teeth, and then to stop and to hold the lower jaw in that position. We then will find that the tactile muscle sense of centric occlusion will stop the mandible as it did prior to extraction of his teeth, and the distance that the mandible travels from rest position will be four thirty-seconds inch. In fact, patients seem to locate their own centric relation more readily than the dentist can.

Apparently the specialized tactile sense of centric occlusion is ever present after extraction of the teeth. Not one edentulous patient has ever failed in the last two years to indicate the same centric occlusion and vertical relation as existed prior to extraction. Even as late as five, six, or nine years after extraction, this highly specialized tactile sense was present. I have found that this sense of centric occlusion is so finely developed that if too much adhesive powder is used, patients chew or squeeze out the excess until they register this sense of centric occlusion. They may even build up enough adhesive powder to prevent the mandible from going beyond centric relation.

After following these deductions, it seems that one of the most hazardous undertakings in making full dentures is changing the vertical relation and centric occlusion as they existed prior to extraction.

As has been mentioned before, there exists a perfect coordination between the muscles, joints, ligaments and natural teeth during mastication, and also during other movements of the mandible at centric occlusion and rest position. We must endeavor to establish an identical coordination of the same tissues with artificial dentures at centric occlusion and rest position. Hence, less time is required to become accustomed to the dentures, and therefore, greater efficiency is obtained in speech and mastication. The farther away we get from this, the more difficult it is for patients to wear artificial dentures.[1]

In measuring the distance between rest position and centric relation between full upper and full lower dentures, as established by other dentists as well as by me, a variation of this distance from two thirty-seconds to nine thirty-seconds inch has been found.

In cases wherein a distance of four thirty-seconds inch was present, perfect satisfaction was expressed. The construction made little difference as regards masticatory efficiency and comfort, in the patient's mind. Each one said, "These teeth feel like my own." While in cases

wherein the centric relation was too widely opened, or the space between rest position and centric relation was less than one-eighth inch, the patients said that they could not use the dentures for mastication. They always experienced soreness on the ridges and on the periphery; the appearance was poor, and their attitude toward dentures was disdainful. In such cases, patients will continue to hammer with the dentures at the ridges, stimulating tissue changes until the eighth inch opening has been obtained. Then they will be able to masticate food with comfort.

In cases in which the space was more than one-eighth inch or the bite was closed too far, the patients were fairly comfortable, but the nose and chin were close together, the patient being dissatisfied with the appearance, and asserting that he could not masticate food well, owing to the fact that his jaws became tired. Apparently, the muscles had been drained of force and strength before the teeth came into their maximum functional relationship.

In a study of immediate denture patients who never closed the jaws without teeth or who never ate a meal without teeth, it was found that centric occlusion and vertical relation were the same as had existed with the natural dentures because these relations did not change during construction of the immediate dentures.

It is neither desirable nor necessary to establish centric occlusion and the vertical relation as they existed prior to extraction in the construction of immediate dentures, because we know that, in these dentures, centric occlusion and the vertical relation are the same as had existed with the natural dentures. We also know that mastication, phonation, deglutition and esthetic values are not impaired. Likewise, such desired results can be obtained by using the tactile muscle sense of centric occlusion in establishing vertical relation. The patient will be able to masticate his first meal with little difficulty. He will not experience soreness of the ridges, and if any soreness results, it will be around the periphery and will be due to overextension of the base or overcompression of the tissues. Speech also will be unimpaired.

It is worthy of note that the tactile muscle sense of centric occlusion can be used along with the following methods now employed in securing centric relation and centric occlusion.

1. If a gothic arch tracing is used, the tactile muscle sense of centric occlusion will provide a means whereby these tracings can be correctly made at the preextraction centric relation, as a gothic arch tracing alone can be made above or below true centric relation as it existed prior to extraction.

2. If the closure of the lips in obtaining the centric relation is the guide, the tactile muscle sense will help to disprove the theory that the lips should be together. The lips are separated just as often as closed both at centric occlusion and in the rest position. However, when the lips are closed, the muscles of the lips gently bring the lips together, but do not hold them in this position, they being mostly held by the saliva and mucus, which seal the lips together.

3. If baseplate rims are trimmed so that they are even with the lips, and high and low lip lines are made, the tactile muscle sense will prove that these are not to be used as guides in securing centric relation.

4. If a mush bite has been used, one will understand why this bite, careless as it is, has been the simplest means whereby the patient and the dentist, either by themselves or together, sometimes secure true centric relation unknowingly and unintentionally.

5. If the sense of facial proportion has been used to determine esthetically the proper opening and closing of the jaws, the tactile muscle sense will assist in developing this sense of proportion.

SUMMARY

1. The rest position of the mandible is an anatomic and physiologic arrangement designed by Nature to give time to restore muscle energy and to rebuild these parts broken down during the process of talking, chewing and smiling and all other movements of the mandible, as these actions tear down the tissues. The rest position is constantly assumed subconsciously, and it is always present. It makes no difference whether the person is edentulous, is an infant or is old.

2. From rest position, the mandible moves a definite distance into centric relation. The distance that the mandible travels from rest position to centric relation in normal cases is four thirty-seconds inch; i.e., one-eighth inch, or the distance the tactile muscle sense will register. We must add that this distance between centric relation and the rest position of the mandible is in accordance with Nature's plan and specification. The same space will also be maintained in persons having the cusps and edges of the natural teeth worn off, although the amount of tooth structure worn off the upper and lower teeth is five thirty-seconds inch. As the teeth slowly wear down, Nature makes the necessary changes in the glenoid fossae and soft tissues.

3. Centric relation is that position of the mandible in its relation to the maxillae wherein both condyles are in a comfortable retruded position in the glenoid fossae, from which functional movements are made. In this position, the muscles of mastication attached to the mandible are capable of exerting their maximum crushing force. Centric occlusion is that relation of the mandible to the maxillae wherein the functional cusp planes of the teeth are in maximum contact. Thus, we find centric relation to be a fixed jaw relation, while centric occlusion is a tooth relation and is constantly changing, influenced by age, extraction and habit. When, in the construction of dentures, these centers have been changed from their former positions as regards the natural teeth, the anatomic and physiologic arrangements are disorganized, and efficiency is greatly impaired.

4. The mandible is an equilateral triangle, the apices being at the heads of the condyles and between the central incisors when the teeth are properly occluded. As long as the teeth function on a plane that is in harmony with mandibular movement resulting from muscular exertion, balance is maintained. Success can result only when the lost teeth have again been restored mechanically to function in harmony with mandibular movements.

5. The tactile muscle sense of centric occlusion remains after the extraction of the upper or lower teeth. The term "tactile muscle sense" can be explained as follows: When the natural teeth come into centric occlusion, reflexes stimulate the masticatory muscles until their strength is dissipated or scattered, while other reflexes stimulate the external pterygoids and the depressor muscles to action, ending the upward movement of the mandible and completing the opening of the jaws. It is through these reflexes that centric occlusion and centric relation are easily established. Thus, one of the most hazardous undertakings in making full dentures, that of changing the vertical relation and centric occlusion as they existed prior to extraction, is being eliminated.

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THE PHYSICAL BASIS FOR THE DESIGN OF INLAYS FOR MAXIMUM RETENTION

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Nashville, Tenn.

THE major force to which a mesioclusal or distoclusal inlay is subjected is the vertical biting force. Since this is true, it is necessary to so design the inlay that this force results in positive retention against the strongest portions of the tooth. This force can be as great as 200 pounds[1, 2]; which alone indicates the importance of preventing it from being directed toward frail tooth structure.

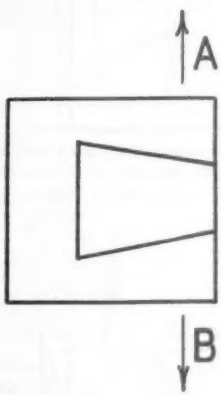

Fig. 1.—Horizontal plane section. If the bottom of the prepared cavity has a slope, as shown in Figure 2, a vertical biting force results in a lateral force out of the cavity. This lateral force, in turn, introduces stresses as indicated at A and B, which tend to split off the sides of the tooth.

We shall consider forces in the axiomesiodistal, the axiobuccolingual and the horizontal planes. The forces in the horizontal plane will be components of the forces occurring in either of the other two planes. The problem is to reduce the forces in the horizontal plane to a minimum or to direct them toward the strongest portions of the tooth.

The retentive feature that is observed most widely in inlays of two or more surfaces lies in the form of the prepared area in a horizontal plane section; i.e., the form or outline as seen in looking vertically down on it. This geometric cross-section is of course important; but if this is the chief or only retentive feature, it means that force is exerted where the tooth structure is weakened. (Fig. 9.)

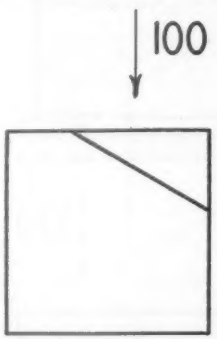

Fig. 2.—Axiomesiodistal plane section. Ignoring the effects of friction and cement, a vertical force of 100 pounds on the inlay results in a lateral force of 57.7 pounds out of prepared cavity when the bottom of the cavity makes an angle of 30 degrees with the horizontal.

If the bottom slope makes an angle of

From the Vanderbilt University Physics Department.

Read before the American Academy of Restorative Dentistry, Cleveland, Ohio, September 1940.

30 degrees with the horizontal and the vertical biting force is assumed to be 100 pounds as shown in Figures 1 and 2, neglecting friction, there will be a force of 57.7 pounds forcing the inlay horizontally out of the prepared cavity. The tooth structure must withstand this force if the cement does not hold. Under these circumstances, the dovetail occlusal retention will act as a wedge, and hence

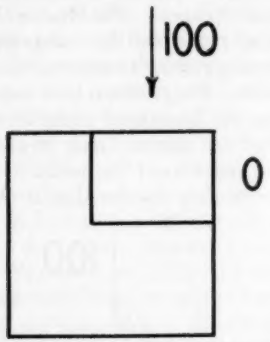

Fig. 3.—Axiomesiodistal plane section. A 100-pound vertical force has no lateral effect.

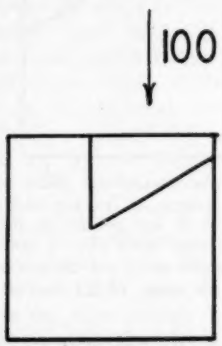

Fig. 4.—Axiomesiodistal plane section. A vertical force of 100 pounds on an inlay results in a 57.7-pound lateral force toward the strong part of the tooth. This gives a positive retention.

there will be a very great force tending to split off the sides of the tooth, as shown in Figure 1, A and B.

However, if the floor of the prepared cavity is perpendicular to the biting force, as shown in Figure 3, there will be no lateral force. This is the neutral condition advocated by Black[1, 3-7] and endorsed by others.

On the other hand, if the base slopes toward the center of the tooth at an angle of 30 degrees from the horizontal and the bite is 100 pounds, a force of 57.7 pounds will be required to pull it out in the absence of any cement or blocking effect by the dovetail section in

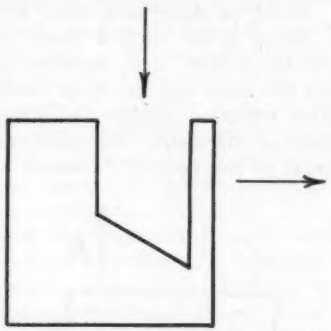

Fig. 5.—Axiobuccolingual plane section. A vertical biting force on the inlay produces a lateral force against the remaining frail wall.

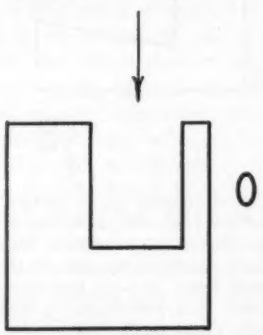

Fig. 6.—Axiobuccolingual plane section. A vertical biting force is neutral.

the horizontal plane. Thus, we see (Fig. 4) that this type of section in the axiomesiodistal plane takes the stress off the frail part of the tooth and does not place reliance on the shearing properties of the cement. (Fig. 10.)

So far the case has been grossly oversimplified. However, these basic prin-

ciples apply to any cavity no matter how complex. It must be particularly borne in mind that the geometric shape is important even when the actual size is small. Thus, the gingival floor can, by proper shaping, contribute to the retentive forces. (Fig. 11.)

We have not yet mentioned the cross-section in the axiobuccolingual plane.

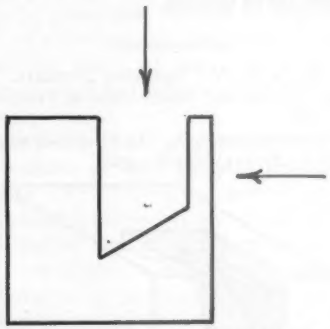

Fig. 7.—Axiobuccolingual plane section. A vertical biting force produces a lateral force against the stronger portion of the tooth, which is best able to withstand the load instead of the frail wall.

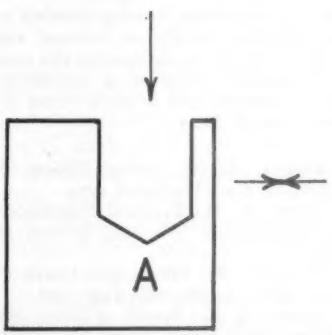

Fig. 8.—Axiobuccolingual plane section. A vertical biting force results in forces directed toward A as an equilibrium position.

The same considerations that hold for the axiomesiodistal plane apply here. Figures 5-8 illustrate the various features. Figure 5 shows the weak side of the tooth getting the brunt of the load, as indicated by the arrow. In Figure 6, the vertical bite is neutral with respect to right or left. The force is to the left toward the stronger part of the tooth in

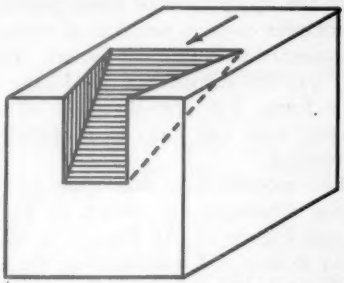

Fig. 9.—Isometric drawing illustrating combined features shown in Figures 1 and 2. A vertical biting force results in a lateral force tending to split off the sides of the tooth.

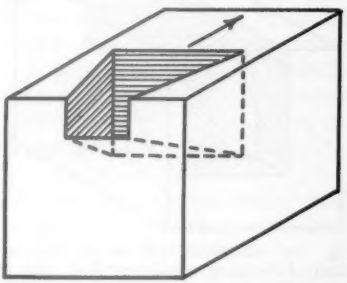

Fig. 10.—Isometric drawing illustrating combined features shown in Figures 1 and 4. A positive retention against the stronger part of the tooth results.

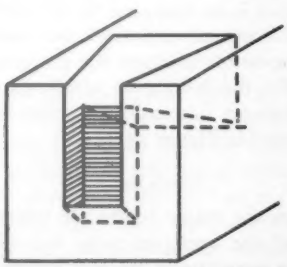

Fig. 11.—Isometric drawing showing both occlusal and gingival floors sloped toward strongest portion of tooth. The desired idealistic distribution of forces is obtained.

Figure 7. The direction of the forces in Figure 8 is toward A as an equilibrium

position. As indicated, the force due to a vertical bite is always transferred in the direction of the bottom slope.

In the application of these principles to complex cavities, we must of necessity be governed by four other factors. These are: (1) the distribution of decay, (2) pulp form, (3) the direction of the enamel rods and (4) the esthetic requirements.

Two modifications that apply to particular situations are shown in Figure 12 and Figure 13. In Figure 12, where decay is deep and undermining, the frail tooth wall is beveled on top and the metal inlay extends over the bevel, thus

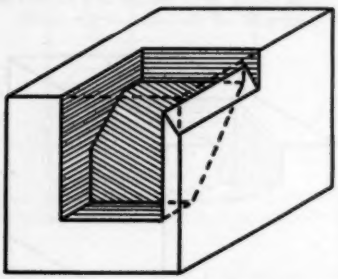

Fig. 12.—Isometric drawing illustrating method of beveling remaining frail wall. The metal inlay extends over this bevel giving definite support to the frail wall. If both walls are frail, both are beveled.

giving this wall definite support. When the decay is so extensive on the root portion or cemental surface of the tooth that it is impossible to shape the gingival wall properly, the inlay must obtain its retentive features occlusally as schematically illustrated in Figure 13.

CONCLUSION

Since the major forces are toward the floor of the prepared area, it is obvious that its geometric form is fundamentally important in determining the stress distribution. The configuration of the surface on which the biting force presses the base of the inlay will determine the magnitude and direction of the lateral forces. This configuration must be such that these lateral forces will be directed toward the strongest portions of the tooth and will hold the inlay in position without the aid of cement.

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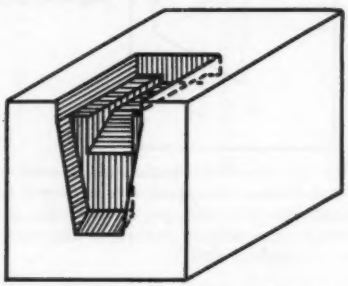

Fig. 13.—Isometric drawing showing tooth cavity extended distally on occlusal aspect. Retentive features are obtained in this manner (i.e., occlusally) when it is impossible to shape the gingival wall properly owing to extensive cemental decay.

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Medical Arts Building.

EXTRACTION WOUNDS AND THERAPEUTIC AGENTS: AN EXPERIMENTAL STUDY

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THIS investigation was undertaken to study the manner in which extraction wounds heal and to compare the effect of the more common types of surgical agents on the healing of such wounds.

It is not within the scope of this study to examine all such agents. The agents studied were selected as representative of the various general types of postextraction surgical dressings. It is not intended that conclusions based on this study be interpreted as recommendations of any particular agent, but it is thought that they may provide some knowledge of the value and the limitations of various general types of dressings used in the treatment of extraction wounds.

The dressings used in extraction wounds to promote healing may be divided into (1) pastes, which may be medicated or nonmedicated, and (2) gauzes, which may be dry or lubricated and medicated or nonmedicated.

One of the earliest agents used in extraction wounds was petrolatum. Exner,[1] in 1915, called attention to the general use of sterile petrolatum in wounds. Lartschneider,[2] in 1929, reported use of this preparation, with excellent results; but little attention was paid to his work. Fridrichovsky[3] used petrolatum to fill extraction wounds completely and tightly sutured the wound to prevent a too rapid escape of the petrolatum. He stated that the postoperative course was remarkably smooth with this method, being characterized by an absence of swelling.

Petrolatum is sometimes used in orthopedic surgery. Its use was popularized by Orr, and the technic of its employment is often termed Orr's method.

There is little to be found in the literature regarding the experimental use of the many medicated pastes. Claflin[4] used medicated dressings in infected wounds in dogs and reported favorable results in the control of pain. Pastes have been used clinically as palliative dressings for painful dry sockets, and are frequently preceded by an escharotic agent,[5] applied to the exposed bone.

Iodoform gauze is commonly used in large extraction wounds, for its antiseptic properties and as a drain.

There are many favorable reports of the use of sulfanilamide in extraction wounds.[6] The drug, in powder or pellet form, is placed in the socket immediately after extraction.

GENERAL ASPECTS OF THE EXPERIMENTAL STUDY

In the experimental study to be reported, adult dogs having normal teeth that were free from periodontal disease were selected. A complete roentgenographic survey of the jaws of each dog was made. The dogs were anesthetized with ether. Anesthesia was maintained with the aid of endotracheal intubation. Some of the extractions were performed while the animals were under the influence of anesthesia induced intravenously with pentobarbital sodium. Twenty-

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five milligrams of pentobarbital sodium per kilogram of body weight was injected intravenously. Ether was the more satisfactory agent, since it maintained a positive airway, permitted better control and produced deeper anesthesia for the actual extraction.

Sterile instruments were used for the surgical procedures. No attempt was made to sterilize the gingivae or the teeth, since it would not have been possible to obtain a sterile field. The wounds studied were considered to be contaminated with the oral bacterial flora. The several teeth removed from each dog were selected in such a manner that no operation disturbed a previous wound. Certain sockets in each dog served as controls. Each dressing studied was placed in one or more sockets in each dog. The teeth were removed at intervals, and as a result, there were healing periods of one, two, three, four, five, seven, ten, seventeen, twenty-four, thirty-one and thirty-eight days, when the dogs were killed and the jaws fixed for sectioning.

A surgical technic of extraction was used on all teeth removed. Incisions were placed in such a manner as to afford wide flaps and an undisturbed shelf of bone adjacent to the alveolus to support the sutured edges of the soft tissues following the removal of the tooth. All of the buccal plate of bone overlying the tooth was removed in each case. The bony septum between the roots of double-rooted teeth was removed. In this manner, all the wounds were kept in as nearly uniform condition as possible. An attempt was made to remove all bone filings and tooth fragments from the sockets before closing. The sockets were all sutured closely with No. 000 seven-day chromic catgut and the sutures were allowed to be absorbed. In most instances, the sutures remained in place three days. The dressings were placed loosely in the sockets. The gauze dressings were removed in three days. The agents in paste form were all readily moldable at body temperature and were left undisturbed as healing progressed. It was necessary to prevent dressings with oily bases from coming in contact with the edges of soft tissue flaps, to assure union at the line of incision.

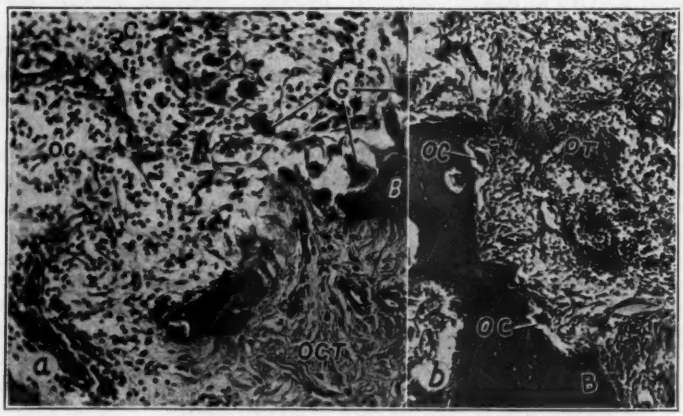

Fig. 1.—a, bone fragments at margin of the socket in a 5 day old wound; B, bone; G, giant cells; OCT, old connective tissue; OC, organizing clot; C, capillaries. (×170.) b: OC, osteoclasts at margin of socket. Osteoid tissue (OT) is forming in the newly organized blood clot and from the margin of the bone at B. (×85.)

The gauze dressings studied were iodo-

form gauze, 5 per cent dry; white petrolatum gauze, and iodoform gauze, 5 per cent, lubricated with Pell's paste.[7] The formula for Pell's paste is:

			Gm. or Cc.
Acetylsalicylic acid	grains	100	6.4
Balsam of Peru	min.	50	3.3
Eugenol	min.	50	3.3
Sodium benzoate	grains	5	0.3
Anhydrous wool fat q.s. ad	ounce	1	29.6

The paste dressings studied were a proprietary paste dressing, Asepta-klot, Baughman's paste, sulfanilamide incorporated in lanolin to form a stiff paste, a proprietary dental ointment, a butyn-metaphen dental ointment manufactured

Bismuth formic iodide (B. F. I. powder)	1.5
Petrolatum (vaselin)	5.0

Proprietary dental ointment	
Butyn	4 per cent
Metaphen	1:1,500
Oily base	

The active constituents of these pastes are each given credit for one or more of the valuable properties claimed for the dressings. Most of the dressings in paste form contain an anodyne, such as benzocaine, acetylsalicylic acid, essential oils, parathesin and guaiacol. All such preparations have some antiseptic properties,

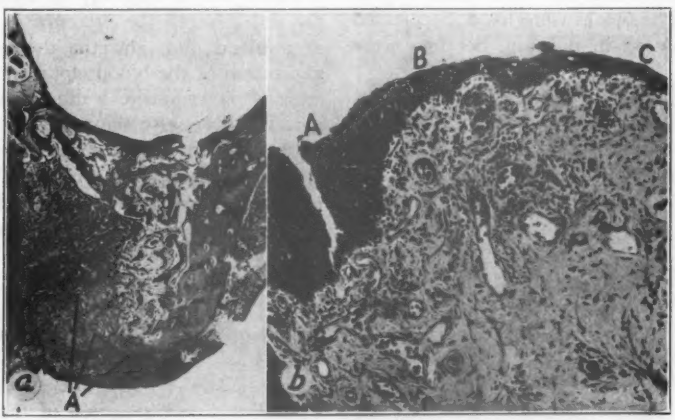

Fig. 2.—a, buccal-lingual section of 38 day old maxillary extraction wound in socket which had contained premolar tooth. The contour of the alveolar ridge has been restored by osteoid tissue at points A. (Petrolatum dressing; ×6.) b, epithelial extension of the prickle-cell layer over incised margin of mucoperiosteum; 2 day old treated wound; old epithelium at A. The distance from B to C represents an extension of 2 mm. (×65.)

by Abbott Laboratories and sterile white petrolatum.

The formulas for these pastes are as follows:

Asepta-Klot	
Iodine, resublimed, U.S.P.	3.5 per cent
Oil of clove, U.S.P.	5.5 per cent
Iodoform, U.S.P.	1.5 per cent
Benzocaine, U.S.P.	3.5 per cent
Organic oils and fats	86.0 per cent

Baughman's paste	Gm.
Ethyl aminobenzoate (parathesin)	1.0
Guaiacol	1.0

and a vehicle which may be a vegetable, mineral or fish oil. In addition, there may be substances added as preservatives and drugs said to promote repair of the injured tissue.

During the experiment, the dogs were fed a balanced ration in soft form containing all the necessary minerals and vitamins. This diet is in the form of a mash, which the dogs picked up with the front teeth and tongue and swallowed without chewing. By means of

this diet, all the dogs maintained their normal weight throughout the experiment. There was no opportunity for the extraction wounds to become traumatized by chewing. Each extraction wound was examined every day, and any variation in the manner of healing was noted.

All the dogs were killed by bleeding while under the influence of anesthesia (ether).

HISTOLOGIC ASPECTS OF THE STUDY

Histologic Preparation.—The disarticulated jaws were cut into blocks, each block containing one extraction wound region. The blocks were fixed, decalcified and mounted in paraffin. Sections were made in a buccal-lingual plane to include a cross-section of the mandible or maxilla and the adjacent soft tissues. Sections at from three to six levels were taken through the blocks, depending on the size of the wound region. Sections from all blocks were stained with hematoxylin and eosin. In addition, sections from certain blocks were stained with azure-eosin, as described by Maximow,[8] as a possible aid in the study of mitotic figures in fibroblasts.

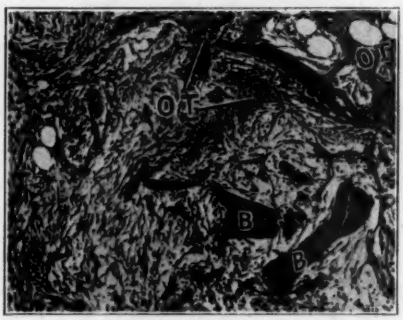

Fig. 3.—Bone fragments in new connective tissue of 10 day old wound. There is little evidence of osteoclastic reaction. OT, osteoid tissue. B, bone. (×60.)

MICROSCOPIC STUDY

The microscopic sections were given numbers, and a complete histologic survey was made without knowledge of the healing time of the wound or the surgical dressing used. The healing periods were then noted on the microscopic slides. The wounds for which equal healing periods had been observed were studied and compared without knowledge of the surgical dressing used in the extraction wounds. The type of dressing used was then noted on each slide. The sections of the control sockets were studied again in an effort to detect any difference in the manner of healing in the several dogs used.

Points noted routinely in the study of the slides were: the presence or absence of a blood clot, and the degree of organization of the blood clot; the appearance of macrophages; the formation of new blood vessels; the presence of fibroblasts; mitosis in fibroblasts; osteoclasis and ossification; the presence of bone filings, tooth fragments and dressings, and the reaction of the tissues to the dressings.

In studying epithelial repair, the following points were observed: reorganization of epithelium at the margins of wounds, extension of epithelium over the region of the wound, the type of cells extending into the region of the wound, the type of base for the epithelial extension, mitosis in the new epithelium, the reorganization of the new epithelium and the complete epithelial covering of the wound.

Results of Histologic Study.—It may be said that the space left in the jaw by the removal of a tooth is immediately filled with a red blood clot. During the first twenty-four hours, the clot appears as a uniform mass of erythrocytes. On the second and third days, the erythrocytes fade and begin to disintegrate, and as a result the network of fibrin is the prominent feature of the clot. Macrophages may be demonstrated at the margins of the clot on the second day, in many respects resembling the fibroblasts,

which soon follow. The macrophages are active in ingesting the distintegrating erythrocytes. The absence of mitosis suggests either that these cells are brought to the region by the blood stream, as claimed by Hartwell,[9] or that the immediate fibrous tissue cells undergo dedifferentiation.

Fibroblasts appear to be invading the clot in 3 to 4 day old wounds. Mitosis could not be demonstrated in these active fibroblasts. As the fibroblasts enter the clot, they begin to stretch out into long fibers (Fig. 1, a).

Cords of endothelial cells may be seen extending into the clot from all sides of the wound in four or five days. These endothelial cells at first are a cord of single cells, but soon thicken and join, forming a capillary. The conversion of the clot to new fibrous tissue was complete in nearly all the 10 day old wounds studied.

In the 4 to 5 day old sockets, there were osteoblasts at the margins of the old bone. These many-shaped cells very soon lay down a uniform matrix containing many osteoblasts, included in small crescent-shaped lacunae. The crescent spaces appear to enlarge into the irregular spaces of cancellous bone and were well developed in much of the osteoid tissue of the 10 day old sockets. The term "osteoid tissue" is used rather than "bone" because little ossification could be demonstrated in the roentgenogram. (Fig. 1, b.)

Data concerning the time required for the organization of the blood clot and the complete filling of the bony defect with osteoid tissue were found to be similar to the data of Claflin[4] and Euler.[10] In the completely healed sockets, the osteoid tissue filled the socket and extended above the crest of the alveolus to give a round contour. (Fig. 2, a.)

Changes at the incised edges of the epithelium were observed in the so-called 24 hour wounds. The cells of the prickle-cell layer became flattened and extended laterally over the cut ends of the subepithelial connective tissue. The extension over the cut connective tissue of the incised edge varied from 0.2 to 1.0 mm. in the 1 day wounds. This extension of the prickle cells over the region of the wound progressed more rapidly over the old connective tissue than over the blood clot (Fig. 2, B), as a result of the irregularity of the surface of the clot and the presence of débris on the surface layer

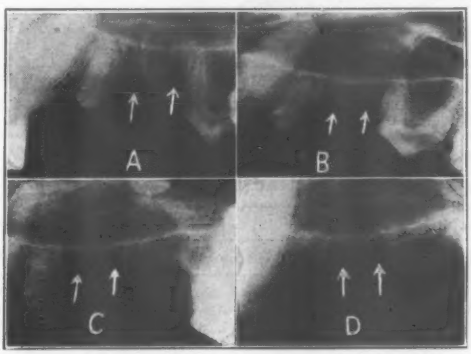

Fig. 4.—Postoperative roentgenograms of maxillary socket that had contained premolar tooth, taken at intervals of (A) seven days, (B) fourteen days, (C) twenty-one days and (D) thirty-five days. The apparent bone repair in Figure 2, a is to be compared with the slight roentgenologic evidence of bone regeneration in D.

of the clot. When débris and irregularity of the surface were present, the epithelial extension spread to cover all portions of the irregular surface. The lateral projection of cells of the prickle-cell layer was first composed of one or two flattened cells at the outer edge. As the extension progressed, the epithelium became stratified and the cells adjacent to the connective tissue or blood clot became rounded and arranged themselves in a basal layer. Mitosis in the old epithelium adjacent to the region of the wound was diminished during the lateral epithelial extension. As epithelial coverage of the region of the wound was completed, the number of mitotic figures in the old epithelium adjacent to the wound area was markedly increased. (Fig 3.)

Spicules of bone could be demonstrated in all wounds. These unattached fragments usually caused no osteoclastic reaction and some acted as centers of ossification. Some contained osteoclasts at several points on one border, while osteoblasts were actively depositing osteoid tissue on another border, as indicated in the accompanying table.

CLINICAL ASPECTS OF THE STUDY

Effect of Applied Dressings.—The reparative changes in the control wounds were similar to changes in the wounds to which dressings had been applied. The first demonstrable signs of repair occurred at the outer borders of the clot and at the cut edges of the epithelium. Since the dressings displaced the central portion of the blood clot, organization of the clot in the sockets with dressings required slightly less time than in those sockets to which dressings had not been applied. There was no demonstrable increase of cellular activity in the treated sockets over similar activity in the control sockets. Since displacement of a portion of the blood clot prevented the clot from forming a bridge across the sutured edges of the mucoperiosteum, complete epithelial covering required slightly more time in treated sockets than in untreated sockets. The complete epithelial coverage

CHRONOLOGIC ORDER OF THE APPEARANCE OF VARIOUS HEALING PROCESSES IN EXTRACTION WOUNDS

Healing Processes, Types	Postoperative Day Healing Was First Noted	
	Control	Treated
Blood clot	1	1
Reorganization of marginal epithelium	1	1
Epithelial extension into region of wound	1	1
Beginning organization of blood clot	2	2
Appearance of macrophages at borders of wound	2	2
Appearance of new fibroblasts in region of wound	3 to 4	3 to 4
Appearance of cords of endothelial cells at borders of wound	4 to 5	4 to 5
Osteoclastic resorption of bone spicules and walls of socket	4	4
Formation of osteoid tissue	5	5
Complete epithelial covering of wound	3 to 5	4 to 7
Complete organization of blood clot to new fibrous tissue	10 to 11	9 to 10
Complete filling of bone defect with osteoid tissue	17 to 24	17 to 24

of the entire wound did not vary enough in the control as compared with the treated sockets to suggest that any one method is particularly superior to another.

Dry Sockets.—Forty-five extraction wounds were studied. Two of these forty-five wounds gave the clinical picture of a dry socket. These pathologic sockets were in the mouth of one dog. One had contained a lower premolar tooth, the other a lower molar tooth. The socket that had held the premolar tooth was sectioned seven days after extraction; the socket that had held the molar tooth, thirty-one days after extraction. The same dressing, a medicated paste on iodoform gauze (5 per cent), had been placed in each socket immediately following extraction of the tooth. No significance could be attached to the occurrence of two dry sockets when the same medication was used, since all other wounds in which this dressing had been used healed very favorably.

Study of the histologic sections revealed a greatly retarded regeneration of new bone. The exposed bone of the alveolus was slowly covered by granulation tissue. The reorganization of this granulation tissue to osteoid tissue was markedly delayed. Control sockets for which the same healing period had been noted contained greater amounts of osteoid tissue than were found in the pathologic sockets.

Miscellaneous Clinical Observations.—All the sockets were observed daily and any deviations from the normal healing process were noted. Healing was uneventful, with the exception of the process in the two dry sockets already described. Results in treated and control sockets were similar. Several of the wounds in sockets that had contained upper molar and premolar teeth were accompanied by swelling of the soft tissues of the cheek in both treated and control wounds. The gingival tissues of these sockets were normal. In several sockets to which lubricated dressings had been applied, there were points of delayed union along the line of the buccal incision, referable to the fact that the dressing came between the incised edges.

ROENTGENOGRAPHIC ASPECTS OF THE STUDY

All roentgenograms were made with the dogs under the influence of general anesthesia. Roentgenograms of the sockets were made immediately following extraction, so that the number of anesthesia periods necessary could be held to a minimum. Roentgenograms of the sockets that were allowed to heal completely were made at seven-day intervals.

The roentgenograms were assembled in film mounts in the order of the healing intervals noted for each socket and were examined for the earliest signs of bone regeneration.

Study of the postoperative roentgenograms for the first signs of regeneration of bone gave negative results. Grossly, the osteoid tissue that filled these wounds was gray and gelatinous. In the decalcified microscopic sections, this tissue appeared to be well-organized cancellous bone. Ossification had not progressed sufficiently, however, to be demonstrated in the roentgenogram. (Fig. 4.)

At necropsy, the jaws were removed and roentgenograms were again made before sectioning. The roentgenographic technic given by Koch[11] was found of value.

SUMMARY AND CONCLUSIONS

An experimental histologic and roentgenographic study was undertaken to compare the effect of applying representative socket dressings to normal extraction wounds. These dressings were classified as (1) pastes, medicated or nonmedicated, and (2) gauzes, dry or lubricated, medicated or nonmedicated.

The experimental and clinical literature on healing of extraction wounds was reviewed. The literature on the heal-

ing of general wounds was studied and correlated with the opinions of writers on the healing of extraction wounds. The use of socket dressings was reviewed in the literature.

Four dogs were used for the study. Forty-five teeth were extracted while the animals were under general anesthesia. Postoperative roentgenograms were made of the sockets at seven-day intervals. Sockets were studied after healing periods of one, two, three, four, five, seven, ten, seventeen, twenty-four, thirty-one and thirty-eight days. Three types of gauze dressings and five types of paste dressings were used. Eleven sockets for which dressings were not used served as controls. Histologic sections were made in a buccal-lingual plane through the sockets, including the adjacent structures of the jaws.

A detailed histologic study was made of the process of healing of extraction wounds. Special attention was given to the effect of the applied dressings on the reparative changes. No cytologic response could be claimed for any of the dressings studied. There were minor differences in the manner of healing of the treated sockets and the control sockets. These variations in healing were referable to the mechanical action of the dressings, which displaced the blood from the central portion of the socket during clot formation. This accounted for the formation of a smaller blood clot in the treated sockets, a clot which was completely organized in slightly less time than that required for the organization of the blood clot in the control sockets. Sockets with dressings required slightly more time for complete epithelial coverage of the region of the wound. Two of the forty-five sockets studied were dry sockets.

Daily clinical observations were made on all of the extraction wounds. No significant differences could be detected between the healing of the control sockets and that of sockets containing dressings.

Postoperative roentgenograms made at seven-day intervals could not be used to demonstrate stages of repair. The osteoid tissue, which filled the defect in the bone in the older wounds studied, and which appeared as bone histologically, actually did not contain sufficient inorganic material to be demonstrated as undergoing ossification in the roentgenogram. This should be remembered when the healing progress of an extraction wound is being judged by the postoperative roentgenogram.

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INFLAMMATION
A REVIEW OF THE LITERATURE

By HARRY D. SPANGENBERG, JR., D.D.S., M.S. in Dent. Surg., Columbus, Ohio

THE inflammatory process plays a most important rôle in everyday dental practice as well as in the laboratory of the pathologist and research worker. Practical applications are numerous, so numerous, in fact, that the fundamentals are frequently forgotten. For this reason, a review of the outstanding literature on this subject seems most timely.

The progress of the earlier workers was hampered because the knowledge of the sciences fundamental to the study of the inflammatory process was not sufficiently developed. As a result, many erroneous conclusions were reached. Therefore, a review of the pertinent literature may be conveniently divided into the historical and recent advances. The historical advances foreshadowed, in many instances, recent investigations. As time progressed, some of the early conclusions were either modified or totally disregarded. Nevertheless, the earlier investigators must be admired for their astute observations whether they were right or wrong in the light of present-day knowledge. It is quite probable that many of the things we believe to be fact today will be proved untrue in the future.

As early as 4000 B. C., the first references to the phenomena and sequelae of the inflammatory process were recorded on papyri found in Egypt. At this time, all disease was referable to demons who haunted the sick. "Companion of pus" is mentioned as the demon that accompanied inflammatory processes. Even at this time, reference is made to the increased vascularity seen in inflamed regions. Hippocrates of Cos[1] (460-370? B. C.) and the Coan school described chills and fever that accompany suppurative processes. With regard to the formation of pus, they held a mechanistic rather than a demonic concept. They believed that pus was putrefied blood, the putrefaction being caused by the increase in temperature of the suppurating regions. Erasistratos[1] (310-250 B. C.) broke somewhat with this school. He maintained that inflammation resulted from an increase in volume of blood in the region.

It remained for Cornelius Celsus[1] (30 B. C.-38 A. D.) in Book III of his "De Re Medicina" to give to modern medicine the classic description of inflammation: "Notae vero inflammationis sunt quatuor, rubor, et tumor, cum calore et dolore." The fifth cardinal symptom, disturbed function, was added at a later date.[2] A description of abscess pointing is found in Book V. As is often the case, Celsus' work was either unknown or considered unimportant by the men of his time, but it did exert great influence on Renaissance medicine.

Galen[1] (129-201 A. D.), a disciple of Hippocrates, knew a great deal about inflammation. He believed that it was caused by an excessive accumulation of the humors in the affected part. He observed that pulsations are often seen in inflamed regions. He considered gangrene a sequela of inflammation that had progressed further than usual. Suppuration was believed to be an essential of the healing of a wound. This unfortunate concept was accepted by his disciples to such an extent that, at a later

period, if "laudable pus" did not occur, attempts were made to produce it. Even as late as 1870, the copious suppuration of wounds, if not actually promoted by filth as in former days, was still considered desirable.

John Hunter,[1,2] (1728-1793) in his "Treatise on Blood, Inflammation and Gunshot Wounds," published posthumously in 1794,[3] felt that inflammation served two purposes, as a defensive mechanism and as a restorative process. He divided inflammation into three groups, the adhesive, the suppurative and the ulcerative types. If the adhesive type failed to control the irritating injury, the suppurative and ulcerative types supervened. He considered suppuration the result of inflammation, which, in turn, was dependent on the vascular structure. Pus originated by a process similar to the process of secretion. This theory was extended by Cruveilhier.[1] Hunter believed that the ulcerative type supplemented the suppurative type in the removal of dead matter. His concepts of repair and union by first intention and regeneration are sound in the light of present-day knowledge.

Inflammation was considered by Jean Cruveilhier[1] (1791-1837) to be characterized by hyperemia with capillary stasis. This caused the capillaries to secrete pus, caseous material or a coagulable lymph. Chambers,[4] in 1863, instead of crediting the capillaries with secretion of pus, postulates that the method is similar to the mechanism of mucus formation. Cruveilhier found inflammation the commonest of all morbid changes and believed that it was linked only with the living state. If inflammation could not be produced in it, a tissue was considered dead. (Our present day methods of pulp testing are based on this fact.) Burdon Sanderson[5] incorporated this idea in his definition of inflammation. It was considered by him to be a "succession of changes occurring in a part as a result of injury, provided that injury be not so excessive as to destroy the vitality of the part."

William Addison,[1] overshadowed by more exhaustive studies in Germany, described many of the vascular and leukocytic responses in inflammation. He recognized and distinguished between mononuclear and polymorphonuclear leukocytes. He considered pus corpuscles altered colorless blood corpuscles and not, as commonly believed, a development from granules and molecules of blood in the inflamed tissue. Some of these views anticipated those held by Cohnheim twenty-five years later.

In 1845, John Hughes Bennett[1,6] (1812-1875) differentiated leukocytosis caused by infection from the changes in the white cells found in the blood stream in cases of leukemia.

Carl Rokitansky[1,7] (1804-1878) divided hyperemia into active, passive and mechanical types. Active hyperemia was considered the first alteration that occurred in inflammation. This was followed by stasis and exudation. He believed that before adsorption could occur in such a region, the inflammatory process must first subside.

In 1834, Rudolph Virchow[1] (1821-1903) wrote as his thesis for graduation a paper on inflammation. He pointed out the fact that irritation was the cause of inflammation and that thrombosis may occur independently of an inflammatory process. This view differed from those held by both Hunter and Cruveilhier, who linked thrombosis and inflammation. Cruveilhier went so far in this belief that he taught that in inflammation the first change was some kind of blood coagulation. Virchow believed that the pus cell is of local origin and described the inflammation of a cell which today is known as "cloudy swelling" (hydropic degeneration) and "intracellular edema."

Friedrich Danial von Recklinghausen,[1] (1883-1910) a pupil of Virchow, investigated inflammation of the cornea. He described fixed tissue cells that take

part in inflammation. He also established, from these studies, the motility of the pus corpuscle. This work stimulated Cohnheim to carry on his monumental studies on the subject.

Julius Cohnheim[1, 8] (1839-1884) broke with tradition on the origin of the pus cell. He performed experiments on the cornea and anterior chamber of the frog's eye. These investigations led him to believe that the pus cell came from the blood stream. He checked his conclusions by placing an irritant on an exposed frog mesentery. From this study, he described capillary dilatation, the slowing of the blood flowing through the capillaries, and the passage of the leukocytes through the capillary wall, with resultant accumulation at the site of injury. In these observations, the cardinal symptoms of inflammation set forth by Celsus became easily explainable. The theory of Virchow favoring a local cellular change in inflammation was placed in the background by Cohnheim. His study again stressed the part that the blood vessels and their contents play in inflammation even as the ancients had done. He did, however, recognize the fact that a low-grade injury did not cause the same degree of vascular changes as did a powerful irritant.[2]

In 1865, Solomon Strickler[1] (1834-1898) discovered the diapedesis of the red blood cell. This discovery elevated him from the ranks of the non-believers and qualified him to meet Cohnheim on his own ground with respect to the origin of the pus cell. Strickler studied the results of placing irritating substances on the cornea of a frog's eye and observed that, prior to any diapedesis, local cells had multiplied and had thereby formed a collection of pus. This investigation once more placed the origin of the pus cell in a state of uncertainty.

Elie Metchnikoff's[1, 9, 10] (1845-1916) distinction between the small (polymorphonuclear) and the large (mononuclear) phagocyte helped to reconcile the two views. He modified Cohnheim's view on the reason for diapedesis. Cohnheim believed that the leukocytes were pushed through the capillary wall, while Metchnikoff maintained that they were attracted through the capillary wall by a force which he called chemotaxis.. In 1884, he showed that leukocytes engulfed and destroyed disease-producing bacteria rather than, as previously supposed, dispersing the bacteria through the body. He called the process of ingestion and destruction of irritants phagocytosis.

J. George Adami[9] correlated the accumulated data on inflammation, pointing out that a tissue exposed to an irritant reacted to that irritant in such a way as to minimize the injurious effects.[11] The type of reaction, he believed, was dependent on the type of irritant. Sometimes one phase of the phenomenon of inflammation predominated, sometimes another. This fact was unrecognized by the earlier pathologists interested in the study of inflammation. Adami observed that the conditions included under inflammation must not be regarded as purposeful; rather, that they must be regarded as indicating the manner in which the organism adapts itself to the irritant. He defines[2] inflammation as "the local adaptive changes resulting from actual or referred injury." The inflammatory reaction is considered reparative rather than destructive. This was by no means a new concept, but was recognized by John Hunter in the latter part of the eighteenth century.

From 1910 to the present time, great advances have been made in understanding the minute mechanisms which are so intricately related to inflammation. Nevertheless, little has been added to the basic features first set forth by the earlier men in this field and crystallized at the beginning of the twentieth century.

The first noticeable alteration in normal tissue subjected to an irritating agent seems to be a brief contraction of the arterioles and capillaries supplying the

part,[2, 9, 12] and a decrease in capillary fragility, followed by dilatation and increase in capillary fragility.[13] The dilatation occurs very slowly.[2] The region in which it occurs, if superficial, becomes red and warm[14] with respect to the surrounding tissue. Adami[2] believes that the phenomenon cannot be caused by nervous stimulation since it occurs as readily in denervated parts. Lewis[15] postulates that the dilatation is caused by an H substance. Morgan[16] does not accept Lewis' theory and he suggests that further study is necessary to find the exact mechanism responsible for dilatation and increase in permeability. Menkin[12] recently isolated from inflamed regions a substance not related chemically either to H substance or histamine. Contact with this substance produces a characteristic dilatation of the arteriole and capillary beds as well as an increase in permeability. Chemically, it seems to be a polypeptid and it is called leukotaxine.[17, 18] It probably originates from the reaction of enzymes present in inflamed tissue.

As the flow of blood is slowed,[2] the larger cells of the blood settle out of the central stream. Shortly thereafter, they adhere to the walls of the venules and, slightly later, to the capillaries.[14] Diapedesis has been observed many times, but just what causes the leukocytes, the lymphocytes and the blood monocytes to migrate over the boundaries of the blood stream is still unsettled.[19] It has been explained on the basis of a positive chemotactic action,[9, 14, 17, 20] or osmotic or electrotropic influences.[19] Various microorganisms[20] have been found to vigorously attract leukocytes, while other agents attract the leukocytes to a lesser degree. After passing through the endothelial walls, these cells progress through the tissue or along strands of fibrin with ameboid-like motion to the region of irritation.[9, 21, 22]

The increase in capillary permeability,[23, 24] with the resultant outflow of plasma, explains the presence of swelling in inflamed regions.[25] According to Opie, this phenomenon is important in relation to immunity since the plasma contains opsonins and agglutinins. Their presence at the point of injury by bacterial agents will help control the tendency to dissemination through the body.[26] The flow of lymph is also increased in the first stages of inflammation.[25] The increase in capillary permeability is caused by the injury to the capillary wall from the irritant[14, 25, 27] or substances released from the tissue by the action of the irritant on it.[17] The area of inflammatory edema is almost entirely plasma.[9, 27] Since the plasma contains fibrinogen, it is possible to have a precipitation of fibrin in and around the inflamed region.[9, 25, 28, 29, 30, 31] This, according to Menkin,[29, 32] is the first step in preventing the dissemination of an irritant throughout the body. Rich[33] takes issue with this statement, showing that the antibodies, especially the agglutinins, are present not only in the plasma, but also, in equal amounts, in the tissue fluids. Freund and Whitney[34] reach the same general conclusions, pointing out further that agglutinins given to rabbits by intravenous injection accumulate more rapidly in the lymph of the liver than in the lymph of the leg. Because of the omnipresence of the agglutinins, the bacteria tend to clump even before the formation of fibrin or the development of the cellular defense.[33, 35] Menkin believes that this mechanism only reinforces the primary mechanism of fixation, that of fibrin formation, and further adds another reinforcing factor, that of anatomic position.[36]

To prove that the formation of fibrin prevents the irritant from diffusing through the tissue, Menkin shows the ability of an inflamed region to retain vital dyes,[30, 37] foreign proteins[38] and bacteria[32] injected into it; also the localization of vital dyes[37] and ferric chlo-

ride,[39, 40] injected intravenously in inflamed regions. It has been further observed that the time required for the formation of fibrin after exposure of a tissue to an irritant varies with the nature of the irritant and the region of irritation.[9, 23] The presence of aleuronat and *Staphlococcus aureus* causes the formation of fibrin in the tissue spaces and lymphatics in a little more than an hour after exposure; of pneumococcus type I, in about eight hours. If Type I serum has been used for immunization, about four hours is required for fibrin to form. When *Streptococcus hemolyticus* is present, about forty-eight hours is needed.[23, 36] In burns, plasma exudes from the wound and lymph flows for several days before there is any fibrin formation, evidenced by the decreased flow.[23, 41]

Concomitant with the increase in plasma filtration in inflammation goes the increase in flow of lymph.[25, 42] That lymph may coagulate was pointed out by Howell in 1914.[43] Lymphatic thrombosis caused by the deposition of fibrin in lymphatics draining inflamed regions has been observed many times.[23, 29, 30, 44, 45] If undisturbed, lymphatic thrombosis probably aids materially in reducing the spread of the irritant from the primary locus. According to Davis,[46] obliterative changes are occasionally found in pulmonary lymph vessels in people that have had pulmonary tuberculosis. This obliteration is caused by a fibroblastic proliferation rather than fibrin formation. Drinker and Field[25] minimize the value of lymphatic thrombosis as an aid in localizing an irritant. They point out that if the inflamed region is massaged, the lymphatic thrombosis does not prevent the flow of lymph into the regional lymph nodes. This is explained by the observation that a clot of fibrin contracts after coagulation. This contraction of clotted lymph in the draining lymph vessels permits the further passage of lymph. In spite of this observation, it seems not unreasonable to assume that lymphatic thrombosis, as well as the formation of fibrin in the tissue spaces, is in some cases helpful in preventing the spread of the irritant from a primary focus until the cells of defense have accumulated.[28, 29] Since the localization of an irritant is one of the initial phases of the inflammatory reaction, it becomes closely related to the mechanism of immunity.[47]

The flow of blood in the capillaries may be slowed to such an extent that there is complete stasis, or sometimes oscillation.[2, 9, 14] Just how the economy of the organism is served by this event it is difficult to explain. Indeed, such stasis may be definitely detrimental.[14]

The literature on the origin and description of cells making up the cytologic picture in inflamed and suppurative lesions is extensive.[19, 48] Jones was probably the first[9] to note that several varieties of white cells were present in the blood stream. This did not appear important until Ehrlich, from 1878 to 1887, in a series of papers described the specific staining reactions of these cells to aniline dyes.[9, 49] Metchnikoff showed that these cells reacted differently to bacteria and foreign particles and, as pointed out previously, distinguished between the "macrophages," which are the large mononuclear phagocytes, and the "microphages," which are the polymorphonuclear cells. The connective tissue cells and fibroblasts also play important rôles in inflammation, especially in the latter stages.[19]

Adami[9] divided the cells taking part in inflammation into three groups: the hematogenous series (the granular leukocytes), the histohematogenous series (lymphocytes and cells derived from them) and the histogenous series (that group of cells originating locally as the result of tissue proliferation).

With respect to the origin and nomenclature of the third group, a great diversity of opinion exists.[19] Many would group all the large phagocytic mononu-

clear cells taking part in the cytologic reaction of inflammation under the term histiocyte, whether the cells originate from fixed tissue cells, the reticuloendothelial system, or[31, 50, 51, 52] the blood monocytes,[31, 51] or differentiate from the agranulocytic series.[31, 51] All of these mononuclear actively phagocytic cells do have certain common characteristics, such as the tendency to attain a large size; the ameboid character of motion; the rounded or kidney-shaped nucleus; the tendency to phagocytize other cells, and the ability to change into fibroblasts. The reticulo-endothelial cells of Aschoff, the clasmatocytes of Ranvier, the resting wandering cells of Maximow, the adventitial cells of Marchand, the histiocytes of Aschoff, the rhagiocrin cells of Renaut,[53] the endothelial leukocytes of Mallory, the polyblasts of Maximow, the macrophages of Metchnikoff and the hyaline cells of Kanthack and Hardy[54] seem to have the common morphologic and functional characteristics just enumerated.[19, 52, 55] Sabin *et al.*[56] and Witts and Webb[57] have shown a difference between the large phagocytes of the blood stream, the monocytes, and those of the tissue, the clasmatocytes (histiocytes), differentiating them by using a supravital technic.[58] Hall,[59] on the other hand, does not feel that the supravital technic is a very accurate method for cellular differentiation. It has been shown that the monocytes may metamorphose into clasmatocytes[56] or histiocytes.[51, 60]

In acute inflammation, the first cell to reach the irritated region is, in the human being, the polymorphonuclear neutrophil,[19, 21, 23, 61] and, in the rabbit, the pseudo-eosinophil.[45] The emigration occurs in an interval of from eight to twenty-four hours after the beginning of the irritation.[12, 19] These cells ingest the irritant, the process being called phagocytosis. Some cells may completely digest the irritant; others may be killed by the irritant. A few of the living cells may return to the blood stream *via* the lymphatics.[62]

The leukocytes when they degenerate (probably not before), may elaborate an enzyme or enzymes[63, 64] capable of rendering the irritant less noxious and more liable to phagocytosis by the other cells.[19] The disintegrated bits of cells also constitute an irritant, which is removed by other phagocytizing cells, usually of the mononuclear type.[9, 21, 31, 60, 61] These cells may also elaborate enzymes,[64] but differ from the leukocytes in that disintegration is not necessary for the activity of the enzyme. Very few of these cells disintegrate.[19]

It is probable that the lymphocytes do not possess any phagocytic property.[19] The issue is not settled, for it has been shown that lymphocytes may be readily transformed into cell forms universally accepted as phagocytic.[21, 60, 65, 66] Hall and Furth,[67] from their study using tissue culture methods, believe that such transformation does not exist. The confusion is not caused by the inability to differentiate morphologically the lymphocytes from the blood monocytes,[56] but rather the inability to determine their origin. Bloom[68] reports the transformation of lymphocytes into monocytes. He has observed that the lymphocytes recovered from the thoracic duct of rabbits may in tissue culture be transformed into pseudo-eosinophils.[66] He adds that there is no evidence to support von Mullendorf in his contention that the special leukocyte and mononuclear phagocytes develop from fibroblasts or from vascular epithelium as Mallory and Herzog[69] supposed.

After the first twenty-four hours, if the irritation continues and is sufficiently severe, the mononuclear cells of the lymphocytic and histiocytic group predominate in the cytologic picture.[12, 19, 23, 28, 45, 51, 60]

The more centrally located cells of the infiltrated zone, the polymorphonuclear leukocytes, degenerate and become necrotic, with the result that frank pus is

formed.[9, 45] There are several conditions, according to Menkin,[36] which appear to play a rôle in this connection. First, there is a tendency to capillary thrombosis,[36, 70] which results in a decrease in the alkaline reserve of the part, probably kept at a constant level by continuous exchange between the fluids of the tissue spaces and the plasma of the blood stream.[36] Secondly, there is a disturbance in the intermediate carbohydrate metabolism of the part, with the result that glycolysis is increased in the central zone and lactic acid is formed. Both conditions appear responsible for the lowering of the pH. The cytologic picture of the zone appears to be related to the prevailing pH, for, with the reduction in pH, there is a marked lethal effect of all types of leukocytes. When the pH reaches a level of 7.0, polymorphonuclear infiltration changes to a mononuclear infiltration. At a pH lower than 6.7, the mononuclear cells are injured. At higher levels of hydrogen-ion concentration, all cells are killed and frank pus results. A transient decrease in pH caused by the presence of cleavage products of tissue proteins has been noted by Bradley[63] in tissue undergoing degeneration.

From the third to the fifth day, young fibroblasts[9, 19, 31, 45] are found at the periphery of the histiocytes and lymphocytes. The origin of the fibroblasts is still a matter of debate,[9, 19, 67] but most of them are probably derived from preexisting connective tissue cells of the part.[19, 31] Others may originate from cells of the histiocytic group[31, 51, 60, 71]; others from the transformation of lymphocytes to fibroblasts through the intermediate state, which is that of the polyblast,[31, 51, 65] or directly from the transformation of the large lymphocyte into fibroblasts.[60]

The fibroblasts elongate and collagen fibrils are produced which surround the entire infiltrated region described above.[19] The connective tissue becomes very dense, and it is the phenomenon of "walling off" that the surgeon waits for before an incision for drainage of an abscessed region is made.

Gradually, the necrotic material and irritant are removed by the histiocytes[21] and carried away by the lymphatics or perhaps the blood stream,[25, 45] which has gradually assumed a more or less normal flow. To facilitate resorption, new blood vessels[9] as well as newly formed lymphatic capillaries[72] pierce the connective tissue boundary.

In inflammatory edema, the resorption of protein, as was pointed out earlier, may occur in two ways,[14] indirectly through the lymphatics or directly *via* the capillaries. The latter mode of resorption is possible because the proteolytic enzymes present in such a region break down the proteins,[63] the cleavage products of which are small enough to be resorbed by the capillaries, as are the crystalloids.

It may be observed, in conclusion, that the inflammatory process is complex, is helpful in localizing irritants and is related to the process of healing of wounds. A thorough understanding of the fundamentals and application of these fundamentals by the dental profession in everyday practice will result in more efficient and valuable service to the patient.

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THE ANACHORETIC EFFECT IN PULPITIS
I. BACTERIOLOGIC STUDIES*

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INTRODUCTION

ANACHORESIS is that phenomenon by which blood-borne bacteria, dyes, pigments, metallic substances, foreign proteins and other materials are attracted to, and fixed in, circumscribed areas of inflammation. Hippocrates is credited with the observation that abscesses may have a favorable effect on prognosis in general infections. Burrows (1932) cites Hoffman and von Recklinghausen (1867) as the first investigators to observe the fixation of dye materials in inflamed organs. The attraction and fixation of various circulating foreign materials have been investigated by a host of research workers.

We undertook an investigation of the many unexplained pulp deaths in noncarious teeth and in some filled teeth at various intervals after dental operations. The generally accepted theory of self-strangulation of the pulp was discarded as physically untenable (Boling and Robinson, 1938). Further studies were directed at experimental production of pulpitis by simple cavity preparation and by cavity preparation plus topical application of irritants. After failure to produce destructive pulpitis under these conditions, the report of Csernyei (1939) suggested the possible rôle of anachoresis. The series of experiments here reported represents one phase of a correlated bacteriologic, histologic and roentgenographic study of the anachoretic phenomenon in the teeth of cats. The roentgenographic and histologic studies will be presented in a subsequent report.

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REVIEW OF THE LITERATURE

Localization and Fixation of Blood-Borne Bacteria and Other Materials.—The localization of circulating bacteria in areas of injury has been recognized from the early days of medicine and is often expressed as *locus minoris resistentiae*. Schüller (1880) introduced tuberculous material into animals' lungs through tracheotomy wounds and simultaneously injured knee joints by twisting. The infection was found not only to be present as a general tuberculous process, but also, and especially, localized about the traumatized joints.

Calmette and Guerin (1901) injected vaccinia virus into the veins and found it localized in previously shaved areas on the backs of rabbits. Pawlowsky (1909) found that streptococci were inhibited from dissemination when injected into inflamed knee joints, although they spread readily from uninjured joints. Lewis (1916) observed that trypan red, given intravenously, appeared in abnormal amounts and with unusual rapidity

in the aqueous humor of slightly congested eyes of rabbits.

Bullock and Cramer (1919) demonstrated the production of lesions by anaerobes, not at the points of inoculation, but in distant areas irritated by the injection of ionizable calcium salts. Netter and Cesari (1923) treated pneumococcal meningitis by the production of fixation abscesses in the thigh. Opie (1924) noted fixation of antigen at the site of injection in immunized animals, and (1929) found that aleuronat-induced peritonitis retarded dissemination of hemolytic organisms subsequently introduced intraperitoneally. Opie also called attention to the importance of the antigen-antibody reaction at the site of injury as a factor in production of local inflammation.

Kettle (1924) localized tubercle bacilli in lesions produced by silica and, to a lesser degree, by calcium chloride injections. Land (1926) used the anachoretic phenomenon to study the fate of circulating particles in the defense cells. Chesney, Turner and Halley (1928) injected treponemata into the testicle and veins of rabbits and invariably produced syphilitic lesions in previously prepared dermal wounds. Findlay (1928) found that in animals prepared by intradermal inoculation of histamine, intravenously injected *Staphylococcus aureus, Streptococcus hemolyticus* and pneumococci localized in the histamine-treated areas. He believed localization to be due to increased capillary dilation and permeability produced by histamine or a histamine-like substance. Spagnol (1928) noted that electronegative dyes localize much more readily than electropositive ones.

In this respect, it should be recalled that bacteria carry negative charges. Menkin (1929, 1930a, 1930b, 1931, 1935, 1940) conducted an extended series of experiments demonstrating the fixation of dyes, metals, foreign proteins and bacteria in areas of induced inflammation. Further studies showed that blood-borne materials are attracted to areas of inflammation and that fixation can occur within thirty minutes after application of the irritant. Quednau (1929), reporting two cases, called attention to the tendency for micro-organisms, especially pneumococci, to localize in areas of cerebral softening. Sager and Nickel (1929) produced sterile abscesses subcutaneously in rabbits and later recovered intravenously inoculated streptococci from the abscesses in some of the animals. They believed that a higher percentage of localization would have been evident if the bacteria had been introduced at earlier stages of inflammation.

Menkin and Menkin (1931) demonstrated the accumulation, in induced tuberculous nodules, of intravenously injected colloidal iron. Rickert (1931), citing clinical cases, directed attention to the localization of bacteria from extra-oral foci in the pulps of filled teeth. Burrows (1932), in addition to reviewing the literature at some length, illustrated the localization of dyes in various areas of inflammation. Accumulation of blood-borne dye in a palatal ulcer is included. Burrows records a number of cases from the literature in which *Treponema pallidum* localized in old tattoo marks. In one case, an obliterated tattoo appeared anew as an Indian, resplendent in red papule outline.

Fox (1936) showed by experiment that younger lesions attracted dye more rapidly than older ones and that the power to collect blood-borne matter persisted longer where the inflammation was induced by stronger irritants. Bareggi (1937) and Ascoli and Nai (1937, 1938) not only observed attraction of bacteria to areas of inflammation, but also noted their retention for long periods of time. Csernyei (1939) credits Ascoli with the introduction of the term anachoresis from the Greek meaning convocation and refuge.

TABLE 1.—RESULTS OF INJECTION OF STREPTOCOCCAL CULTURE, INTRAVENOUSLY, AFTER OPERATIVE INTERFERENCE AND IRRITATION

Cat	Tooth Position	Operative Procedure*	Time Between Application of Irritant and Injection	Time Between Injection and Death	Cultural Studies			
					Circulating Blood Time	Culture	Heart's Blood (Terminal)	Tooth
47	$\overline{7}$	Cav.	29 min.	4 days	4 min.	Negative	Negative	Negative
	$\overline{6}$	Cav.	10 days	4 days	4 min.	Negative	Negative	Negative
	$\lfloor\overline{6}$	CO	17 days	4 days	4 min.	Negative	Negative	Positive (mixed)
	$\lfloor\overline{7}$			4 days	4 min.	Negative	Negative	Negative
	$\lceil\overline{6}$			4 days	4 min.	Negative	Negative	Negative
	$\overline{6}\rfloor$			4 days	4 min.	Negative	Negative	Negative
21	$\overline{7}$	CO	30 min.	7 days			Positive (cocci)	Positive (cocci)
	$\lceil\overline{7}$			7 days			Positive (cocci)	Negative
48	$\lfloor\overline{7}$	CO	17 min.	8 days			Positive (cocci)	Positive (short rods)
	$\lceil\overline{6}$	Cav.	3 days	8 days			Positive (cocci)	Positive (cocci)
	$\lfloor\overline{6}$	CO	17 days	8 days			Positive (cocci)	Positive (cocci)
	$\overline{7}$			8 days			Positive (cocci)	Negative
	$\overline{6}$			8 days			Positive (cocci)	Negative
	$\overline{6}\rfloor$			8 days			Positive (cocci)	Negative
65†	$\overline{7}$	CO	7 days	13 days			Negative	Positive (cocci)
	$\lceil\overline{5}$	CO	13 days	13 days			Negative	Negative
	$\overline{6}$	CO	21 days	13 days			Negative	Negative
	$\lfloor\overline{7}$			13 days			Negative	Negative
	$\overline{5}$			13 days			Negative	Negative
	$\lfloor\overline{6}$			13 days			Negative	Negative
67†	$\lfloor\overline{6}$	CO	38 min.	13 days			Negative	Negative
	$\lceil\overline{6}$	CO	7 days	13 days			Negative	Positive (cocci)
	$\lfloor\overline{7}$	CO	14 days	13 days			Negative	Positive (cocci)
	$\overline{6}$			13 days			Negative	Negative
	$\overline{6}$			13 days			Negative	Negative
	$\overline{7}\rfloor$			13 days			Negative	Negative
29	$\overline{7}$	CO	42 min. & 10 days	18 & 28 days				Positive (cocci)
	$\lceil\overline{6}$	CO	2 & 12 days	18 & 28 days				Negative
	$\overline{6}\rfloor$	CO	7 & 17 days	18 & 28 days				Positive (cocci)
	$\lfloor\overline{7}$			18 & 28 days				Negative
	$\overline{6}$			18 & 28 days				Negative
	$\overline{7}\rfloor$			18 & 28 days				Negative
34‡	$\overline{6}$	CO	8 min.	30 days			Positive (cocci)	Positive (cocci)
	$\overline{6}$	CO	9 days	30 days			Positive (cocci)	Positive (cocci)
	$\overline{7}$	CO	16 days	30 days			Positive (cocci)	Positive (cocci)
	$\lceil\overline{6}$			30 days			Positive (cocci)	Negative
	$\lceil\overline{6}$			30 days			Positive (cocci)	Negative
	$\lfloor\overline{7}$			30 days			Positive (cocci)	Negative

42	$\overline{7}$	CO	28 min.	30 days	16 min.	Negative	Negative	Positive (cocci)
	$\overline{6}$	CO	7 days	30 days	16 min.	Negative	Negative	Positive (cocci)
	$\lfloor 6$	CO	14 days	30 days	16 min.	Negative	Negative	Negative
	$\lfloor 7$			30 days	16 min.	Negative	Negative	Positive (cocci)
	$\lfloor 6$			30 days	16 min.	Negative	Negative	Negative
	$\overline{6}$			30 days	16 min.	Negative	Negative	Negative
35	$\overline{6}$	CO	40 min.	30 days			Positive (strep.)	Positive (cocci)
	$\overline{6}$	CO	9 days	30 days			Positive (strep.)	Positive (cocci)
	$\overline{7}$	CO (exposed)	16 days	30 days			Positive (strep.)	Positive (cocci)
	$\lfloor 6$			30 days			Positive (strep.)	Negative
	$\lfloor 6$			30 days			Positive (strep.)	Negative
	$\lfloor 7$			30 days			Positive (strep.)	Negative
33	$\overline{6}$	CO	45 min.	30 days			Negative	Positive (cocci & rods)
	$\overline{6}$	CO	9 days	30 days			Negative	Positive (cocci)
	$\overline{7}$	CO	16 days	30 days			Negative	Positive (cocci)
	$\lfloor 6$			30 days			Negative	Negative
	$\lfloor 6$			30 days			Negative	Negative
	$\lfloor 7$			30 days			Negative	Negative
27	$\overline{7}$	CO	33 min.	2 months				Positive (cocci)
	$\lfloor 6$	CO	2 days	2 months				Positive (cocci)
	$\lfloor 7$			2 months				Negative
	$\overline{6}$			2 months				Negative

*CO, croton oil applied in cavity; Cav., cavity preparation only.
†Streptococci from Cat 56. ‡Given two extra pentobarbital sodium injections.

Rigdon (1939) confirmed the observation of Fox that younger lesions attract dyes more readily; finding that xylene-induced areas of inflammation failed to attract dyes and foreign proteins one to five days following application of the irritant. Csernyei (1939) provoked chronic periapical inflammation in dogs and, after several weeks, injected Bang bacilli *(Brucella abortus)* in the saphenous veins. Three weeks later, the pulpless teeth and the controls were extracted and suspensions prepared from them for inoculation in guinea-pigs. After from three to four weeks, the guinea-pig sera were tested for agglutinins against the Bang bacillus. The results of this investigation clearly indicated that areas of chronic periapical inflammation can attract bacteria from the blood stream and that the fixed bacteria can remain vital.

LOCALIZATION AND FIXATION OF BLOOD-BORNE BACTERIA

Investigation has shown that positive blood cultures are sometimes obtained from apparently healthy, normal individuals. Cameron, Rae and Murphy (1931) found eighteen positive blood cultures among 100 from supposedly healthy subjects, although twelve of these were considered contaminated. Butler (1937), by carefully controlled methods, observed growth in blood cultures in from only two to fifty healthy young adults, and he believes that, with present methods, less than 5 per cent of normal individuals will yield positive blood cultures. Among persons with infected sinuses, tonsils, teeth and other foci, the incidence of bacteremia observable from time to time will, presumably, be somewhat higher. Okell and Elliott (1935) found micro-organisms from the blood of ten of 110 patients with pyorrhea.

A number of investigators have studied the incidence of bacteremia after operations. Seifert (1925) found not only that there were seven positive blood cul-

TABLE 2.—RESULTS OF INJECTION OF STAPHYLOCOCCAL SUSPENSION AFTER PULP IRRITATION

Cat	Tooth Position	Operative Procedure*	Time Between Application of Irritant and Injection	Time Between Injection and Death Days	Titer Millions	Cultural Studies			
						Circulating Blood		Heart's Blood	Tooth
						Time Min.	Culture		
81	⌊7	CO	28 min.	9	130	5	Positive (staph.)	Positive (staph.)	Positive (staph.)
	6	CO	7 days	9	130	5	Positive (staph.)	Positive (staph.)	Negative
	⌊6	CO	14 days	9	130	5	Positive (staph.)	Positive (staph.)	Positive (mixed)
	7⌋			9	130		Positive (staph.)	Positive (staph.)	Negative
	⌈6			9	130		Positive (staph.)	Positive (staph.)	Negative
	6⌋			9	130		Positive (staph.)	Positive (staph.)	Negative
72	⌈7	Phenol	25 min.	12	185	7	Negative	Positive (staph.)	Positive (staph.)
	⌊6	CO (exposed)	13 days	12	185	7	Negative	Positive (staph.)	Negative
	⌈6	CO	20 days	12	185	7	Negative	Positive (staph.)	Positive (staph.)
	7⌉			12	185	7	Negative	Positive (staph.)	Negative
	6⌉			12	185	7	Negative	Positive (staph.)	Negative
	6⌉			12	185	7	Negative	Positive (staph.)	Negative
74	⌊7	Phenol	10 min.	14	4	4	Positive (staph.)	Negative	Negative
	⌊6	Phenol	7 days	14	4	4	Positive (staph.)	Negative	Negative
	⌈6	CO	14 days	14	4	4	Positive (staph.)	Negative	Positive (strep. & staph.)
	7⌋			14	4	4	Positive (staph.)	Negative	Negative
	6⌉			14	4	4	Positive (staph.)	Negative	Negative
	6⌉			14	4	4	Positive (staph.)	Negative	Negative
73	⌊7	Phenol	15 min.	14	4	7	Positive (staph. & rods)	Negative	Negative
	⌊6	Phenol	7 days	14	4	7	Positive (staph. & rods)	Negative	Negative
	⌈6	CO	14 days	14	4	7	Positive (staph. & rods)	Negative	Positive (staph. & rods)
	7⌋			14	4	7	Positive (staph. & rods)	Negative	Negative
	6⌉			14	4	7	Positive (staph. & rods)	Negative	Negative
	6⌉			14	4	7	Positive (staph. & rods)	Negative	Negative
71	⌈7	CO	27 min.	14	87	7	Negative	Positive (staph.)	Negative
	⌊6	CO	11 days	14	87	7	Negative	Positive (staph.)	Positive (mixed)
	⌈6	CO	18 days	14	87	7	Negative	Positive (staph.)	Positive (mixed)
	7⌋			14	87	7	Negative	Positive (staph.)	Negative
	6⌉			14	87	7	Negative	Positive (staph.)	Negative
	6⌉			14	87	7	Negative	Positive (staph.)	Negative

83	$\overline{6}$			10	130			Negative	Negative
	$\underline{6}$			10	130			Negative	Negative
	$\lfloor\overline{7}$			10	130			Negative	Negative
84	$\overline{5}$			10	130	5	Positive (cocci)	Positive (cocci)	Negative
	$\lfloor\overline{6}$			10	130	5	Positive (cocci)	Positive (cocci)	Negative
	$\underline{6}$			10	130	5	Positive (cocci)	Positive (cocci)	Negative
	$\lfloor\overline{7}$			10	130	5	Positive (cocci)	Positive (cocci)	Negative

*CO, croton oil applied to cavity; Phenol, phenol applied to cavity.

tures in twenty-two goiter operations, but also that operating in, reexamining or changing dressings in infected areas was followed by bacteremia in eighty-two of 195 instances. Scott (1925), in a study of eighty-two cases of bacteremia associated with urologic disease, found fifty-one following operations. A high incidence of blood infection after urethral operations was also observed by Barrington and Wright (1930). Tonsillectomy may be followed by bacteremia as noted after four of sixty-four operations by Bartlett and Pratt (1931) and after sixteen of fifty-one by Fischer and Gottdenker (1936).

The speed with which the blood can be cleared of bacteria has been emphasized by most workers in directing attention to the importance of taking blood specimens immediately or shortly after operation. Reichel (1939) showed the speed of blood clearing in an experimental study, expressing the belief that positive postoperative cultures will not persist unless (1) there is a focus of infection in the vascular system itself, or (2) an abscess is draining into the blood or (3) the invading organism is not affected by the defense system of the body.

Attention has been directed to the possible rôle of postextraction bacteremia in various diseases. Richard (1932) irritated various infected foci and produced bacteremia. Massaging the gingivae and rocking the teeth for ten minutes were followed by bacteremia in three of seventeen individuals. Okell and Elliott (1935) examined blood cultures from 138 patients before and after extraction of teeth. Before extraction, only twelve were positive (nine from persons with extensive periodontal disease), but, postoperatively, eighty-four were positive. Round, Kirkpatrick and Hails (1936) obtained two positive blood cultures from ten persons with oral sepsis after mastication of hard candy. Fish and MacLean (1936) mention their confirmation of Okell and Elliott's observation "by producing positive blood cultures in nine cases of pyorrhea after multiple extraction."

Burket and Burn (1937) reported transient bacteremia following extraction in 17 per cent of 204 cases. By the use of *Serratia marcescens,* they showed that organisms from the gingival crevice may be forced into the blood stream during extraction of teeth. Elliott (1939), after rocking teeth, found eighteen cases of bacteremia in twenty-one cases of "marked gum disease" and five in twenty cases without detectable gum disease. Multiple extraction was followed by 75, 70 and 34 per cent positive blood cultures from "marked gum disease" (forty cases), "moderate gum disease" (sixty cases) and in the absence of "detectable gum disease" (thirty-eight cases), respectively. Bartels (1940), who has reviewed the literature on bacteremia in dental relationships, cites two additional cases of bacteremia following tooth extraction.

It is unimportant, for the purpose of this study, whether a bacteremia is preceded by operative interference in the oral or extra-oral region, whether it is

TABLE 3.—RESULTS OF PULPAL IRRITATION IN CATS WITHOUT BACTERIAL INJECTION (NON-INFECTED AND NATURAL INFECTIONS)

Cat	Tooth Position	*Operative Procedure	Time Between Application of Irritant and Death	Cultural Studies			
				Circulating Blood	Heart (Terminal)	Tooth	Remarks
82	⌈7	CO	3 min.			Negative	Infected eyes (mixed culture predominantly cocci); died under anesthetic
	6	CO	7 days			Positive (mixed)	
	⌊6	CO	14 days			Positive (rods)	
	7⌋					Negative	
	⌈6					Negative	
	6⌋					Negative	
63	⌈7	CO	3 days		Positive (strep.)	Positive (cocci)	Infected eyes and ulcer on left lower lip (mixed culture predominantly cocci)
	⌊6	CO (exposed)	10 days		Positive (strep.)	Positive (cocci)	
	⌈6	CO	18 days		Positive (strep.)	Positive (mixed)	
	7⌋				Positive (strep.)	Negative	
	6⌋				Positive (strep.)	Negative	
	6⌋				Positive (strep.)	Negative	
56	⌈7	CO	7 days	Positive (mixed)	Positive (mixed)	Negative	Large abscess behind right ear (mixed culture predominantly cocci)
	6⌋	CO	20 days	Positive (mixed)	Positive (mixed)	Positive (mixed)	
	⌊6	CO (exposed)	27 days	Positive (mixed)	Positive (mixed)	Positive (mixed)	
	⌈6			Positive (mixed)	Positive (mixed)	Positive (mixed)	
	7⌋			Positive (mixed)	Positive (mixed)	Negative	
	6⌋			Positive (mixed)	Positive (mixed)	Positive (mixed)	
64	7⌋	CO	20 days	Negative	Negative	Positive (staph.)	Infected eyes (mixed culture, predominantly cocci)
	⌈5	CO	26 days	Negative	Negative	Positive (cocci)	
	⌊6	CO	34 days	Negative	Negative	Negative	
	6⌋			Negative	Negative	Positive (mixed)	
	⌈7			Negative	Negative	Negative	
	⌈5			Negative	Negative	Negative	
75	7⌋	Phenol	14 days	Positive (staph.)	Negative	Positive (diplococci)	Infected eyes (mixed culture predominantly cocci)
	⌊6	Phenol	21 days	Positive (staph.)	Negative	Negative	
	⌈6	CO	28 days	Positive (staph.)	Negative	Positive (mixed)	
	⌈7			Positive (staph.)	Negative	Negative	
	6⌋			Positive (staph.)	Negative	Negative	
	6⌋			Positive (staph.)	Negative	Negative	
51	7⌋	CO	7 days		Positive (staph.)	Positive (cocci)	No symptoms of general or local infection
	⌈6	CO	14 days		Positive (staph.)	Positive (mixed)	
	⌊6	CO	21 days		Positive (staph.)	Negative	
	6⌋				Positive (staph.)	Negative	
	6⌋				Positive (staph.)	Positive (staph.)	
	⌈7				Positive (staph).	Positive (cocci)	
52	7⌋	CO	7 days		Negative	Negative	No symptoms of general or local infection
	⌈6	Cav.	14 days		Negative	Negative	
	6⌋	Cav.	28 days		Negative	Negative	
	⌈7				Negative	Negative	
	6⌋				Negative	Negative	
	⌈6				Negative	Negative	

*CO, croton oil applied in cavity; Phenol, phenol applied in cavity; Cav., cavity preparation only.

associated with focal infection or is one of the rarer blood invasions in a healthy individual. The important consideration is that transient bacteremia does exist at times in ambulatory patients and in apparently normal, healthy persons.

METHOD

The animals used in these experiments were adult cats in which the permanent dentition had been completed. During the course of the investigation, the animals were maintained on a stock diet and indoors, with adequate room for exercise.

At each operation, sodium pentobarbital, veterinary, was administered intraperitoneally as an anesthetic. Cavities were prepared in selected teeth at various intervals, efforts being directed toward making each cavity as deep as possible without actually exposing the pulp. The teeth were operated upon in pairs so that one tooth could be used for bacteriologic and one for histologic study. In most cavities, croton oil was applied as an irritant at the time of operation. In a few instances, pure phenol was substituted for croton oil or the open cavities were left untreated. (Tables 1-6.) The cavities were left open in all cases. Suspensions of bacteria were injected in a vein of the hind leg from a few minutes to twenty days after cavity preparation.

The animals were allowed to live from four to sixty days after bacteremia developed and were then killed. Just prior to death, and while the animal was under anesthesia, samples of heart's blood were taken for culturing and, immediately after death, the jaws were dissected and roentgenographed. The jaws were then scrubbed thoroughly with alcohol and held in sterile gauze while the surface layers of enamel and dentin were removed by sterile burs. Before the pulp chambers were entered, fresh sterile burs were substituted to prevent, as far as possible, carrying infected material from the outside into the pulps. The pulps, after exposure, were pierced by sterile barbed broaches. The broaches were twisted and were withdrawn, and the ends were cut off with sterile cutters and dropped into media prepared from bacto-brain-heart infusion, dehydrated. Cultures were made from the teeth operated upon and, in each instance, from control teeth in the same positions in the opposite sides of the jaws. The teeth operated upon and which had been prepared at the same time were cut out *in situ* to be used for histologic studies.

In the first series of experiments, thirty cavities were prepared in the teeth of eleven cats. (Table 1.) In twenty-seven cavities, croton oil was applied at the time of cavity preparation. Three cavities were left without drug treatment.

TABLE 4.—RESULTS OF INJECTION OF STREPTOCOCCI BEFORE CAVITY PREPARATION

Cat	Tooth Position	Operative Treatment	Time Between Injection and Irritation	Time Between Irritation and Death	Cultural Studies	
					Heart	Tooth
30	$\frac{6}{7}$	CO	1 day	14 days	Positive (strep.)	Positive (cocci)
	$\frac{7}{6}$	CO	8 days	7 days	Positive (strep.)	Positive (cocci)
	$\frac{6}{7}$				Positive (strep.)	Negative
	$\frac{7}{6}$				Positive (strep.)	Negative
32	$\frac{7}{7}$	CO	1 day	14 days	Positive (cocci)	Positive (cocci)
	$\frac{7}{7}$	CO	8 days	7 days	Positive (cocci)	Positive (cocci)
	$\frac{7}{7}$				Positive (cocci)	Positive (cocci)
	$\frac{7}{7}$				Positive (cocci)	Positive (cocci)

From four days to two months after application of the irritants, 1 cc. of suspensions of streptococci in brain broth was injected intravenously. The organisms used in nine animals were from a hemolytic strain obtained from an infected human being. In two cats, the streptococci were cultured from another cat with a naturally acquired infection. One cubic centimeter of circulating blood from one animal was cultured four minutes after injection of bacteria, and 1 cc. from another animal was taken after sixteen minutes.

In the second series of experiments, fifteen cavities were prepared in the teeth of five cats. (Table 2.) Croton oil was applied in ten cavities and pure phenol in five. At intervals of from nine to fourteen days after application of the irritants, 1-cc. portions of saline suspensions of *Staphylococcus aureus* were injected into the hind leg veins. The staphylococci were from a stock laboratory strain. Cultures were made from 1-cc. samples of the circulating blood at short intervals (two to seven minutes) after inoculation. Two additional animals were injected with these organisms, although no operative work had been performed on any of their teeth. Cultures from some of their pulps were taken as additional controls.

In the third series of experiments, five cats with evidence of naturally acquired infection and two cats with no apparent symptoms of infection were used. (Table 3.) Croton oil was applied in seventeen cavities and phenol in two. Two were left untreated. The animals were killed within from three minutes

Anachoretic pulpitis accompanying experimental bacteremia.

	Streptococcal infection	Staphylococcal infection	Total
Animals injected after croton oil treatment	11	5	16
Animals with positive pulpal cultures from treated teeth	11(100%)	5(100%)	16(100%)
Animals with positive pulpal cultures from control teeth	1(9%)	0 (0%)	1(6.5%)
Teeth treated with croton oil	27	10	37
Croton oil treated teeth with positive cultures	22(82%)	7(70%)	29(78%)
Teeth treated with phenol	0	5	5
Phenol treated teeth with positive cultures	—	1(20%)	1(20%)
Teeth with cavity preparation alone	3	0	3
Teeth with only cavity preparation and positive cultures	1(33%)	—	1(33%)
Control (unoperated) teeth	30	22	52
Control teeth with positive cultures	1(3%)	0 (0%)	1(2%)
Operated teeth with positive cultures (combined)	23(77%)	8(53%)	21(69%)

Figure 1.

to as long as thirty-four days after application of the irritants.

In the fourth experimental series, suspensions of the same streptococcal strain used in ten cats of series I were injected intravenously into two cats. (Table 4.) At periods of one and eight days after inoculation, in each animal, cavities were prepared in four teeth and croton oil applied. Seven days after application of the croton oil, the animals were killed.

Necropsies were performed on a number of the experimentally infected cats, and in no instance was there any evidence of infection of the viscera. The animals with naturally acquired disease showed no abnormalities of the viscera, but infection at the original sites persisted.

Anachoretic pulpitis accompanying naturally acquired infection.

	Number	Percentage
Animals with positive pulpal cultures from operated teeth	5	100
Animals with positive pulpal cultures from control teeth	2	40
Croton oil treated teeth with positive cultures	10	77
Phenol treated teeth with positive cultures	1	50
Control (inoperated) teeth with positive cultures	3	20

Figure 2.

Although the results here reported are for only twenty-seven animals, a larger number were used in the investigations. Nine cats that died in the course of the experiments were saved for histologic study; but to avoid the possibility of postmortem invasion, the pulps were not used for bacteriologic study. In additional animals that died, the tissues were unsuitable for any phase of the investigation or the work completed was inadequate.

EXPERIMENTAL DATA

Series I (Streptococci).—Positive bacterial cultures were obtained from twenty-two (82 per cent) of the twenty-seven teeth to which croton oil had been applied. One (33 per cent) of the three teeth in which the cavities were left untreated yielded a positive pupal culture and one (3 per cent) of the thirty control teeth gave evidence of bacterial invasion of the pulp. Cultures prepared from the circulating blood of two animals immediately after inoculation were both negative. In four of the eleven animals, the heart's blood was found to be infected just before death. The cultures were merely classified as "cocci" or "mixed," since it is extremely difficult to differentiate streptococci, diplococci and staphylococci on the basis of structure alone, and because further classification was not considered essential to this study. All of the positive heart's blood cultures showed pure cocci. Twenty of the treated tooth cultures consisted of pure cocci and one showed cocci and rods, one short rods and one a mixed culture. The one positive culture from a control tooth showed pure cocci. None of the reported positive cultures in this or the following series is considered contaminated. In one animal of this series (No. 29), a second injection was given by mistake ten days after the initial injection. The possibility of serum shock as a cause of the general

reaction should be considered. The data for series I are summarized in Table 1.

Series II (Staphylococci).—From seven (70 per cent) of the ten teeth to which croton oil had been applied, positive pulp cultures were obtained. Of these, three showed pure staphylococcal forms, one staphylococcal and streptococcal arrangement, one staphylococci and rod forms and two mixed bacteria. Of five croton-oil-treated teeth, one (20 per cent) was infected. In none of the twenty-two control teeth were there any culturally demonstrable bacteria. Three of the animals with prepared cavities yielded positive blood cultures shortly after bacterial injection. One of these three animals, and the other two cats, had bacteria in the heart's blood just before they were killed. Two of the early cases of bacteremia were of pure staphylococcal forms and one also showed rods. Morphologically, all three of the heart's blood cultures were of pure staphylococci. In two additional animals, injected with the same strain of staphylococcus, no teeth were irritated. Six pulps were examined and all were bacteria free, although one animal had a bacteremia five minutes after injection and infected heart's blood at the time of death. The data for these experiments are summarized in Table 2.

Series III (Naturally Acquired Infections).—Five cats had demonstrable infection on or near the body surface which was not produced by any experimental procedure. It is assumed that these were "naturally acquired" infections. In four instances, there was profuse flow of pus from the eye and subsequent loss of the eyeball. One of these animals also had an ulceration on the lower lip. In the fifth animal, a large postaural abscess was present. From all these areas of infection, mixed cultures, predominantly coccal, were obtained. An additional animal with clinical and bacteriologic evidence of Vincent's infection was started in this series, but died before completion of the experimental period. Single examinations were made of the circulating blood of three of the five animals. The blood was infected in two and bacteria-free in the third. Heart's blood cultures from two animals were positive at the time of death, two were negative and one was not examined. Thirteen cavities were prepared and treated with croton oil. Of these, ten (77 per cent) yielded positive pulp cultures. In addition, one (50 per cent) of two phenol-treated teeth had an infected pulp. Fifteen teeth served as controls and three (20 per cent) had infected pulps. Two animals with no visible symptoms of infection were operated

Relation between duration of irritant and infection of pulps

Time between application of irritant and injection of bacteria	Number of teeth	Positive cultures
Less than one hour	10	8(80%)
Two to seven days	6	5(83%)
Nine to fourteen days	12	8(67%)
Sixteen to twenty days	7	7(100%)

Figure 3.

upon with this group. One had a positive heart's culture at the time of death, while the other was negative. Two of the three croton-oil-treated teeth and two of the control teeth from the animal with the infected blood yielded positive pulp cultures. In the animal that had negative blood cultures, all treated and control teeth examined were uninfected. This animal reacted as did those in preliminary studies: when the pulp was irritated, but no bacteria were present in the circulating blood, destructive pulpitis was not found. Data from this series are summarized in Table 3.

Series IV (Streptococci Before Irritation).—The strain of streptococcus used in ten cats of Series I was injected intravenously in two animals. At intervals of one day and one week after the inoculation, cavities were prepared and croton oil applied to the teeth of each animal. One week after preparation of the later cavities, cultures were made of the heart's blood and the animals were killed. In both animals, the heart's blood was infected. The pulps from the two irritated teeth were culturally positive in one animal, while the control teeth were negative. In the other animal, all pulps examined (two experimental and two control) were infected. The data from these two animals are given in Table 4.

The data from Tables 1 and 2 are summarized in Figure 1. The data from Table 3 are summarized in Figure 2. The data on cats 51 and 52 have been omitted from the summary. Number 51 showed no infected lesions, but had a bacteremia just prior to death. Number 52 was evidently a healthy, normal animal and all teeth remained uninfected.

Relation between tooth position and infection of pulp.

Tooth position	Number of teeth	Number infected	Percent infected	Number of teeth	Number infected	Percent infected
Maxillary right second premolar	6	5	83	16	14	87.5
Maxillary right carnassial	10	9	90			
Maxillary left second premolar	12	7	58	19	11	57.5
Maxillary left carnassial	7	4	57			
Mandibular right second premolar	7	6	86	9	8	89
Mandibular right carnassial	2	2	100			
Mandibular left first premolar	2	1	50	14	12	86
Mandibular left second premolar	10	9	90			
Mandibular left carnassial	2	2	100			

Figure 4.

COMMENT

The localization and fixation of bacteria in the pulps of these experimental animals are even more striking than in previous comparable studies of fixation in other tissues and regions. While forty-six (72 per cent) of the pulps from the sixty-four teeth operated upon were infected, only six (8.5 per cent) of the seventy-one control pulps yielded posi-

tive cultures. Of the six infected pulps from teeth not operated upon, four were from two animals with bacteria in the heart's blood just prior to death. In none of the cats with naturally acquired infection or induced bacteremia did all the pulps operated on escape infection.

Those teeth in which croton oil was applied to the cut dentinal surface at the base of the cavity responded more nearly uniformly than those with phenol or without any irritation other than that produced by the cavity preparation. Of the fifty croton-oil-treated teeth, thirty-nine (78 per cent) were infected. Only two (29 per cent) of the seven phenol-treated teeth and one (33 per cent) of the three teeth with a simple cavity preparation were bacteriologically positive. This result is in agreement with the observation of Fox (1936) that areas of inflammation induced by stronger irritants are more persistent in attracting blood-borne material.

It was not possible to show that younger lesions in the dental pulp are more capable of attracting and fixing bacteria, although Fox (1936) and Rigdon (1939) demonstrated increased powers in younger lesions in other sites. In considering this relationship, only uniformly (croton oil) treated teeth were analyzed. Of the thirty-five pulps that can be tabulated, twenty-seven (77 per cent) were infected. (Fig. 3.) In this study, there are a number of factors other than time which must be considered. The incidence of infected pulps is so high that statistical analysis would be of little value. The depth of the cavity is highly important, a fact that has been shown in the investigations by Van Huysen and Gurley (1939).

Deep cavities *per se* seem to be more irritating to the dental pulp, and our method did not assure a uniform distance between the floor of the cavity and the wall of the pulp. The dilution of the irritant may be dependent on the size, shape and position of the cavity and on the flow of saliva. The form of the pulp cavity must be considered, for it makes the inflammatory process in the dental pulp unique. Swelling, a normal response to inflammation, is limited in the pulp by the inelastic dentinal walls. Although simple self-strangulation is not probable, there may be back pressure on the capillary bed (Boling and Robinson, 1938). This morphologic peculiarity may account for the high incidence of infected pulps in this experiment and for the relative unimportance of the age of the lesions. While bacteria may occasionally escape from areas of inflammation circumscribed only by the process of lymph blockage, the added natural dentinal barrier which allows escape only through the small apical foramina in the tooth reduces the opportunity for escape and places less burden on the lymph barrier. By the same structural peculiarity, the age of the lesion would be reduced in importance.

The position of the tooth seemed of little importance. Although one quadrant of the mouth, the maxillary left, showed fewer infected pulps in experimental teeth, this finding is not considered significant. (Fig. 4.) Only three different types of teeth were used, first and second premolars and carnassials, and numbers of each are too small for comparative study.

It is not within the scope of this paper to discuss the details of the mechanism by which inflamed areas attract and retain bacteria. Menkin (1940) considers the fixation primarily due to mechanical obstruction caused by a fibrin network and thrombosis of efferent lymphatics. Among possible conditions leading to fixation, Burrows (1932) lists increase in osmotic pressure in the transuded material, stasis of lymph, phagocytosis, agglutination of bacteria *in vivo,* electrostatic conditions of the tissue and the electrical charge on bacteria.

Irritation of the pulp may result from

mechanical trauma, chemical stimulation and thermal or electrical shock, as well as from bacterial invasion. It has been shown by Jeserich (1935), Van Huysen and Gurley (1939) and others that cutting of a cavity may *per se* result in pulpal changes. It is also recognized that the use of plastic filling materials may have a pulpal response (Gurley and Van Huysen, 1937, 1940) and that large metallic fillings may conduct heat to the pulp (Kronfeld, 1939). Faillo and Reed (1940) have clearly shown the ability of the pulp to receive material through the fresh-cut dentin. The irritation of the pulp from cavity preparation, the placing of filling materials, the use of sterilizing drugs, heat and cold and other common stimuli is ordinarily not so severe as that produced experimentally by the use of croton oil. However, in many instances, the pulpal inflammation produced may be capable of attracting and fixing bacteria present in the blood stream during a transient bacteremia.

For localization and fixation of bacteria by anachoresis, the only requirements are (1) a circumscribed area of inflammation and (2) circulating microorganisms. A certain number of teeth in which deep or extensive fillings have been placed may fulfil the first requirement. The second will be supplied by any transient bacteremia. The incidence of dental cases presenting such a combination of conditions will be small when compared with the high incidence under the experimental conditions described.

Clinically, however, teeth are encountered which give no evidence of pulpal or periapical pathosis at the time of cavity preparation. At a later date, a toothache may develop, and examination may reveal an infected pulp or a periapical lesion. The possible course of events may have been (1) operative or postoperative irritation of the pulp with production of asymptomatic pulpitis; (2) subsequent development of a transient bacteremia, or (3) anachoresis with infection of the pulp. Such pulpal inflammations that may occur at long intervals after dental treatment are now classified as idiopathic, a term which all too often denotes lack of specific knowledge. A more appropriate term would be "anachoretic pulpitis."

SUMMARY AND CONCLUSIONS

In this series of experiments, in which the pulps of teeth were irritated and bacteria introduced into the blood stream, the teeth of other animals, in which naturally acquired infection existed, were also irritated. Forty-six (72 per cent) of the pulps from sixty-four teeth operated upon were infected, while only six (8.5 per cent) of the seventy-one control pulps showed bacteria, culturally. The peculiar structure of the pulp cavity, offering an unyielding dentinal chamber with relatively small openings for ingress and egress, may increase the importance of the anachoretic effect in the dental pulp.

Since (1) irritation of the pulp is known to result, at times, from cavity preparation, application of filling materials, thermal stimuli and other conditions, and since (2) transient bacteremia may, occasionally, be present in normal, healthy individuals, it is suggested that certain cases of postoperative "idiopathic" pulpitis may be a result of anachoresis. The term "anachoretic pulpitis" is suggested for this pulpal inflammation.

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A NEW THREE-QUARTER CROWN PREPARATION AND BRIDGE ATTACHMENT

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THE purpose of this paper is to present an original idea in preparing a three-quarter crown for a bridge attachment. It is a new and simple approach to the old and difficult problem of replacing one or two posterior teeth, either by the fixed or by the semi-fixed bridge. This new type attachment is designed for reducing the trauma incident to preparation of the abutment teeth, differing from the traditional type attachment in that it is inserted lingually rather than vertically.

In order to appreciate the principle involved in this new attachment, let us consider the present type three-quarter crown now in use. In the preparation of the present type three-quarter cast crown, the mesial and distal proximal surfaces are sliced, the slices converging toward the occlusal surface. Since the natural tooth presents a greater circumference at the midportion and the occlusal portion than at the cervical, much tooth structure must be removed to eliminate undercuts. (Fig. 1A.) The lingual surface of the natural tooth presents a convexity which causes an undercut and so must be ground with a slight taper toward the occlusal surface. A groove is then cut across the occlusal surface from mesial to distal aspect, and another groove is placed within the slices from the occlusal groove to the cervical margin. Sufficient tooth structure is also removed from the occlusal surface to allow for the gold of the three-quarter cast crown. (Fig. 1B.)

Because of the amount of cutting just described, one can readily see that considerable tooth structure must be removed from the natural tooth in making the conventional three-quarter cast crown. Furthermore, if the tooth to be used as the abutment is tipped either mesially or distally, even more tooth structure must be removed from the proximal surfaces in order to insert the completed bridge in the vertical plane.

In contrast, in this new three-quarter cast crown, regardless of the bell shape of the natural teeth, the mesial and distal proximal slices are made with no attempt to remove the undercuts, but rather allowing the slices to follow the natural inclination of the proximal surface of the tooth, and thus the slices will diverge rather than converge at the occlusal portion. (Fig. 2A.) Sufficient tooth structure is then removed from the occlusal surface up to the incisal edge of the buccal cusps to allow for the gold replacement. The lingual surface, regardless of its convexity, is left untouched. Next, the grooves (Fig. 2C) are placed within the limits of the proximal slice, running diagonally from the mesiolinguoclusal point angle to the mesiobuccogingival point angle (Fig. 2B) and, similarly, on the distal slice. It is obvious that the copper band impression must be taken from the lingual aspect. (Fig. 3.)

In festooning, the copper band is trimmed to include all but the buccal surface. To take the impression, the copper band is gently forced into position in the same plane as that of the grooves, and, after the compound is chilled, any

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surplus that extends on the buccal surface is removed. Figure 4 illustrates the replacement of a lower left first molar. If a completely fixed bridge is to be constructed, a three-quarter cast crown on the second premolar must be made as in the second molar. However, if a semifixed principle is the choice, a three-quarter crown on the premolar is not necessary and a simple distoclusal inlay will suffice. A movable joint in the distoclusal inlay of the second premolar is necessary in order for the bridge to function with the new three-quarter cast crown.

Obviously, if this new bridge is to be inserted from the lingual aspect, the countersunk occlusal rest, as at present used, cannot be employed as it is made to function with vertical insertion of the bridge.

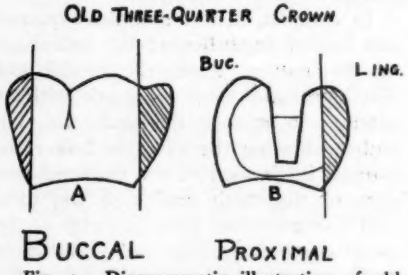

Fig. 1.—Diagrammatic illustration of old, or conventional, three-quarter crown. A, buccal view, showing mesial and distal slices converging toward occlusal surface, and amount of tooth structure removed (indicated by diagonal lines). B, lingual view, showing taper of lingual surface toward occlusal surface, amount of tooth structure removed and proximal and occlusal grooves.

Figure 5 shows the type of groove necessary for the movable joint in the distoclusal inlay of the second premolar. This groove, which is placed midway between the marginal ridge and the cervical margin (Fig. 5B), is about 2 mm. deep, 0.5 mm. wide and in length extends four-fifths of the buccolingual dimension of the distoclusal inlay. It is made parallel with the groove on the molar after preparation for the three-quarter crown and has a downward inclination; that is, the part of the groove next to the pontic (Fig. 5A) is nearer the occlusal surface by 1 mm. than that part of the groove nearest the tooth itself (Fig. 5B), so that a definite lock is established which will prevent the abutment teeth from drifting away from each other.

The construction of this movable attachment is a very simple laboratory procedure. As these castings are made by the indirect method, the amalgam dies of the abutment teeth are in position on the cast, which is mounted on a small articulator, with a cast of the teeth of the opposite jaw.

1. The wax pattern of the distoclusal inlay of the premolar is carved to anatomic form and articulation.

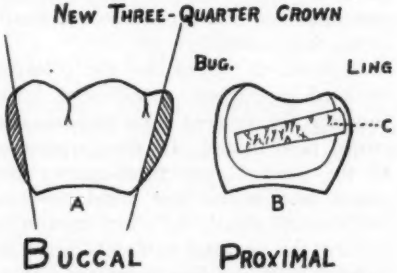

Fig. 2.—Diagrammatic illustration of new three-quarter crown. A, buccal view, showing mesial and distal slices diverging toward occlusal surface, and amount of tooth structure removed (indicated by diagonal lines). B, proximal view, showing diagonal groove (C), within limits of slice, and the unaltered lingual surface.

2. About 1 mm. of wax is added to the proximal portion of the inlay for greater convexity to give added bulk for the depth of the groove.

3. With the groove of the molar prepared for the three-quarter crown as a guide, a parallel line is inscribed on the wax pattern of the premolar with a pointed instrument.

4. Gold that is purchased in rectangular form is about 0.5 mm. thick and is

Fig. 3.—Upper molar with copper band impression partly seated. The arrow on the copper band indicates the angle of insertion parallel to the groove partly visible on the proximal surface.

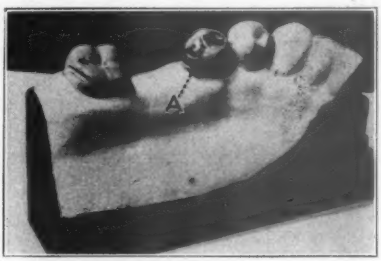

Fig. 4.—Replacement of lower left first molar. A, groove on distoclusal inlay parallel to groove on new type three-quarter crown of molar.

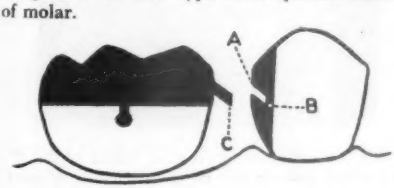

Fig. 5.—Diagrammatic illustration of details of movable joint. The angulation of groove A, on the distoclusal inlay of the bicuspid, and of C, on the gold portion of the pontic, permits locking them together in seating and prevents drifting of the abutment teeth.

Fig. 6.—Lingual view of completed bridge showing movable joint (A) in position.

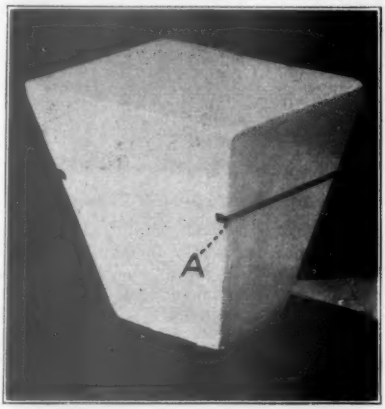

Fig. 7.—Geometric figure with opposite sides parallel. A, only possible path of insertion for three-quarter casting.

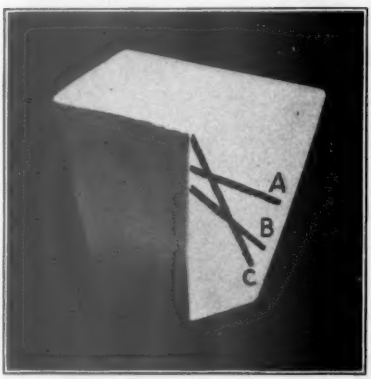

Fig. 8.—Geometric figure with two opposite sides converging. A, B, C, paths of insertion for three-quarter casting.

the instrument used to make this groove. By heating this gold slightly and placing it on the inscribed line with a back and forth motion, a uniform, smooth groove

A B

Fig. 9.—A, proximal view of lower first bicuspid, showing groove farther from horizontal than groove of B, on lower second bicuspid, because proximal surfaces of A converge toward lingual more than toward proximal surfaces of B.

Fig. 10.—Buccal view of upper first molar illustrating divergence of slices at occlusal surface.

is developed, which is cast with the inlay. (Fig. 4A.)

5. The porcelain pontic is now selected and ground. The wax pattern for the gold portion of the pontic is carved to anatomic form and occlusion and placed in position on the working cast.

6. A piece about 4 by 3 mm. is cut

Fig. 11.—Lingual view of upper molar.

Fig. 12.—Proximal view of upper molar illustrating parallelism of groove with lingual cusps and unaltered lingual surface with convexity.

from the rectangular sheet of casting gold mentioned above. The piece is heated and placed in the groove of the

distoclusal inlay and, with slight force, guided to position in the wax pattern of the pontic. This portion is now cast as an integral part of the pontic pattern, and any surplus that extends lingually can be polished in finishing the bridge. The usual procedure is followed in assembling and soldering the bridge. Figure 6A shows the attachment in position.

SUMMARY AND CONCLUSION

In the form of the posterior teeth, Nature has presented us with a convenient geometric figure that makes this new three-quarter crown possible. If we wish to make a casting to cover four surfaces of the geometric figure in Figure 7 to simulate a three-quarter crown, there is only one path of insertion for that

Fig. 13.—Buccal view of completed bridge showing small amount of gold visible on buccal surface.

casting, and that path of insertion will be in the horizontal plane indicated by the line A. If we alter the geometric form of Figure 7 so that two opposite sides converge (Fig. 8), we have a geometric figure that truly represents the form of the posterior teeth. Now, if a casting is to be made for this geometric figure to cover four surfaces, we have not only a horizontal path of insertion, but also the paths of insertions indicated by the lines A, B, and C and any other lines that may be drawn between them.

From the above-described geometric design, we deduce these facts: 1. The greater the convergence of two opposite sides which represent the proximal surfaces, the farther from the horizontal will the grooves be placed. 2. The less the convergence of two opposite sides, the nearer the horizontal will the grooves be placed. These facts are illustrated in Figure 9. A shows a lower first premolar whose proximal surfaces converge more than those of B, a lower second premolar. Therefore, the proximal surfaces of A will be farther from the horizontal than those of B. If advantage is taken of the path of insertion farthest from the horizontal, less grinding of the lingual cusps will be necessary.

This method of bridge construction offers many advantages over the old:

1. Less tooth structure is lost.

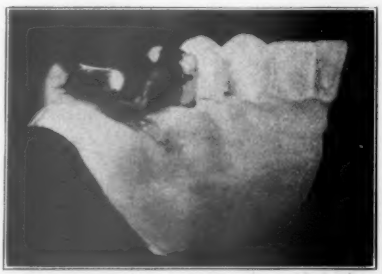

Fig. 14.—Lingual view of completed bridge partly seated to indicate path of insertion governed by groove visible on second molar.

2. The operating time is greatly reduced.

3. There is less trauma to the tooth.

4. Less pain is experienced.

5. There is better cervical adaptation, and so less irritation to soft tissue due to overhang of gold and food traps.

6. Less gold is visible on the buccal surface.

7. No thermal shock is felt after the bridge is cemented, because there is no deep grinding.

8. Regardless of the tilt of the tooth, the preparation is the same as though the tooth were vertical.

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EARLY DIAGNOSIS AND TREATMENT OF OSTEOMYELITIS OF THE MANDIBLE

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IN the past few years, volumes have been written on the subject of osteomyelitis of the mandible. Recently an increasing number of cases have been reported in nurslings and infants. One might assume from these facts that the incidence of this disease entity is increasing. The apparent increase is actually due to more accurate diagnosis. Osteomyelitis of the mandible is still discussed with emphasis on the severity of the infection and the amount of bone destruction. Infection of teeth or the wholesale extraction thereof with procaine hydrochloride is accepted as the etiology. In treatment, conservatism is the guiding thought.

The disease is caused by pyogenic organisms which enter the jaw from some focus; in the mandible, usually a tooth. Hematogenous infection of the mandible is rare. That teeth are the chief etiologic factor of the disease in this bone is also evidenced by the fact that osteomyelitis of the mandible in an edentulous jaw is rare. The majority of cases occur in adults, being relatively uncommon in children during the first decade of life.

In the subcutaneous tissues, infection with pyogenic cocci results in an acute inflammation. As the bacteria increase in number, the adjacent cells are destroyed, necrosis occurs and pus is formed. The extravasation of fluid into the tissues, the dilatation of the blood vessels, the accumulation of phagocytic cells, especially leukocytes, and the proliferation of connective tissue cells cause swelling and tend to wall off the infection. When the process occurs in a nonexpansive compartment, such as bone, the changes mentioned are modified and the bacteria invade and destroy the cancellous bone, spreading to the periphery. It is noteworthy that in the subcutaneous tissues pain and tenderness occur early, while in bone the focus may be quiescent for a few days, and if a tooth is the focus, it may be the only source of complaint. Most bones are devoid of sensation and the inflammation must reach the periosteum before intense pain is noted. In the mandible, however, pain along the course of the mandibular nerve is noted along with pain in the tooth, which is a symptom even before the inflammation has reached the periosteum.

There is a wide variation in the course and prognosis of individual cases of osteomyelitis. An increase in the patient's resistance or a decrease in the virulence of the organism will tend to cure the disease, and the converse is also true. Care must be taken not to lower the patient's resistance unless sufficient benefit will accrue to justify the procedure. It is accepted that an operation tends to lower the patient's resistance at least temporarily and that the ill effects vary directly with the extent of the operation and the duration and type of anesthetic used.

The usual clinical history is that of a patient suffering from an aching tooth. The patient seeks dental counsel and

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one of three procedures is usually followed: The tooth is extracted, usually with procaine, as it is the most widely used anesthetic in the dental field today; the pulp chamber may be opened, in an attempt to establish drainage through the tooth, or the patient is sent home with instructions to apply heat or occasionally an icebag to the affected part. If the latter is used, the patient usually returns the following day and demands the removal of the tooth, as the pain has become almost unbearable. Quite often, the removal of this focus relieves the pain, and slowly healing takes place.

Occasionally, and much to the amazement of all concerned, the pain continues, with increasing fever and general malaise. Often these constitutional symptoms of a bacterial infection are overlooked, and at a later date, surgical measures, such as cutting down to the periosteum or the stripping up of the periosteum in the hope of finding pus, are instituted. Usually, the objective symptoms are increased each time additional incisions are made. Finally, after a stormy course, with increased swelling, roentgen studies are made, and behold! shadows appear which resemble sequestrating bone. For the first time, the acute process has subsided, as drainage through the cortical plate has been established spontaneously. A soft tissue abscess develops and, if not incised, it too ruptures spontaneously. With surgical interference, the soft tissue abscess subsides more quickly, but draining sinuses persist until more adequate drainage of the area of infection in the mandible has been instituted. Sequestra develop, and often they too are dislodged spontaneously as they become separated from the living bone. As a result, the process continues for months and often years, with considerable anxiety on the part of the patient or embarrassment on the part of the dentist who extracted the tooth.

In my experience, the removal of the tooth has little, if anything, to do with the cause of the infection. In many cases, the removal of the focus has eliminated what might have been a severe osteomyelitis. In some, one is led to believe that the extraction of the tooth caused the severe infection. In my opinion, if the organisms are virulent and the infection is in the bone, the extraction of the tooth neither starts nor stops such an infection.

The question for us to decide, and early in such cases, is, "Is this an os-

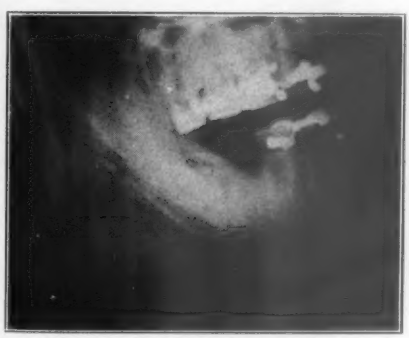

Fig. 1.—Lateral jaw roentgenogram giving no evidence of osteomyelitis of left side of mandible.

Fig. 2.—Condition seventeen days from onset of pain; showing early x-ray evidence of osteomyelitis of mandible below mesial root socket of extracted lower left second molar and drainage openings in bicuspid region made three days previously.

teomyelitis of the mandible; and, if so, what treatment should be followed?" In my opinion, once a diagnosis of osteomyelitis of the mandible has been established by the clinical history and physical findings, and even days before there is roentgenologic evidence of such a process, drainage of this area in the mandible should be instituted. The earlier adequate drainage of the disease process in the mandible is instituted, the quicker will recovery ensue. Also, deformity will be minimized.

Many surgeons believe that the early stage of osteomyelitis is analogous to a spreading cellulitis and that it is a fundamental principle of surgery not to incise in a spreading cellulitis but to immobilize the part and apply local heat

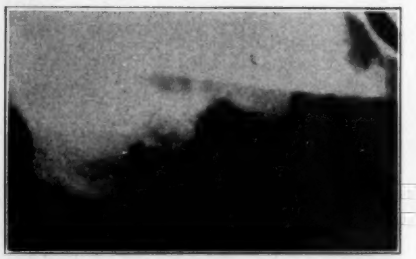

Fig. 3.—Large opening in body of mandible where outer cortical plate had been removed.

until the infection has been localized and local tissue immunity has been established. It is questionable whether there is sufficient local concentration of antibodies around an area of pyogenic infection to be of clinical importance. It is my belief that localization of a pyogenic infection is an anatomic phenomenon rather than an immunologic one. In a non-expansile compartment such as the mandible, there is considerable difficulty in mechanically walling off an infection. The thrombi become septic and aid rather than hinder the spread of the disease. Some maintain also that the amount of destruction is due to the degree of thrombosis in the arteries of the infected bone. If this is true, why does the active destructive process cease when early drainage is instituted and maintained, as evidenced by the relief of pain and fall in temperature?

DIAGNOSIS

As stated previously, diagnosis of developing osteomyelitis of the mandible should be made clinically even before there is roentgenologic evidence if one wishes to limit extension and lessen the resulting deformity. In some cases, this is difficult. Fortunately, however, in such instances, the infection is frequently

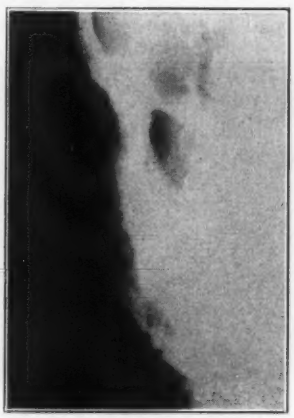

Fig. 4 (February 12, 1938).—Evidence of extensive osteomyelitis of ramus of left mandible in which early drainage was not instituted.

less virulent, and often only local destruction ensues.

All acute local conditions causing pain in the lower jaw should be considered and carefully ruled out before arriving at a diagnosis of osteomyelitis. Localized pain is usually one of the first symptoms of an infection regardless of its location. In bone infections, pain is most severe and almost constant. There may be no early positive objective findings, only subjective and confusing symptoms. In a few days, however, more

positive evidence of an infection develops. If an osteomyelitis is developing, a diagnostic aid of extreme value is local pain on pressure which increases daily in the direction in which the infection is spreading, either anteriorly or posteriorly.

From this and other symptoms, such as an increasing leukocytosis together with general malaise and fever, one can be sure that there is pus present between the cortical plates of bone. If such is the case, whether the x-ray findings are positive or not, drainage should be instituted. The mandible should be roentgenographed in all cases, but the findings should not be relied on entirely until sufficient time has elapsed for the conditions present to be demonstrable on an x-ray plate.

Fig. 5 (June 25, 1938).—Bone repair in body of mandible.

TREATMENT

All patients suffering from severe infection of the mandible should be hospitalized if possible, so that more effective observation and treatment can be instituted. Early, when suppuration is doubtful, these cases should be treated as an acute inflammation. In brief, one should support the patient by advising bed rest, a high caloric diet and fluids, especially if the patient has become dehydrated. Throbbing pain is often the major symptom, in severe cases relieved only by opiates.

Application of hot, moist dressings to the jaw, a universal practice, can be supplemented in some cases with one or more fractional erythema doses of the x-rays. Large doses of sulfanilamide have been advised. Sulfathiazole may be of definite value.

Blood and urine analysis should be made daily with special reference to the white count and the Schilling index. Blood cultures are important, especially if positive. Roentgenologic studies of the infected mandible should be made early and repeated at intervals.

Daily observations of the patient, with careful analysis of the symptoms and laboratory findings, are necessary for early diagnosis of osteomyelitis.

Fig. 6 (November 17, 1939).—Further bone repair. As an experiment, root canals were filled with guttapercha and their apices removed.

When confirmed clinically, the suppurative area in the mandible should be drained. If one waits till the diagnosis is confirmed by a roentgenogram, much unnecessary destruction has taken place.

In my opinion, these suppurative areas in the mandible should be drained early by an intra-oral incision along the affected region. The periosteum is retracted, but not elevated, and an opening made through the cortical plate by means of a hand drill or with a surgical bur if accessibility is difficult. Two or more openings should be made below the apices of the teeth and parallel

to the lower border of the mandible. This is a closed cavity, and no pus will escape if only one small opening is made. Whether the cortical plate is removed between these openings depends on the severity of the infection and the extent of the abscess cavity, which can be further determined, at this time, by the insertion of a small blunt probe through these openings.

Infections of the ramus are more difficult to treat. Early intra-oral drainage in the region of the third molar will often prevent the infection from spreading to the condyle or coronoid processes. Later, extra-oral drainage may be necessary for adequate drainage in infections of the rami and those of the body when soft tissue infection from secondary invasion becomes localized.

After drainage has been instituted, the next problem is to maintain it. Packing vaselin gauze lightly in the cavity helps to prevent the wound from closing. After a few days, the cavity may become closed with débris and granulation tissue. A secondary surgical interference is then advisable in order to keep the cavity open. As the sequestra present themselves, they should be removed. Vigorous curetting of the bone is contra-indicated in all stages of this disease. After a few weeks, when the infection has subsided, curetting out the small sequestra may be necessary to maintain drainage and prevent further destruction of healthy bone from contiguity.

The anesthetic agent to be used in these cases is also an important factor. A light anesthesia under nitrous oxide-oxygen, ethylene or vinethene should be used in preference to a deep anesthesia under ether. Procaine hydrochloride is contra-indicated, especially at the time infection is at its height. In subsequent surgical interference, block anesthesia in conjunction with nitrous oxide-oxygen to the stage of analgesia may be the method of choice, especially in the aged. With an increasing number of anesthetic agents at our disposal, we should select the one most indicated for these cases.

Early cases of osteomyelitis of the mandible are usually seen by the dental surgeon because intense pain and suffering are experienced by the patient. This being the case, every man in the field of oral surgery should be aware of the disease and, when confronted with a case of osteomyelitis, should render adequate treatment. Early diagnosis and early treatment will often save the patient

Fig. 7 (August 14, 1940).—Almost complete bone repair. The first molar tooth has been removed. These bicuspids are functional, but may be removed at a later date, to be replaced by a mechanical restoration.

Fig. 8 (August 14, 1940).—Complete repair of body of mandible where cortical plate was removed for drainage; showing deformity of angle of jaw where early drainage was not instituted.

many months of prolonged agony and perhaps years of unnecessary deformity.

CASE REPORTS

CASE 1.—A man, aged 32, seen at the hospital, January 12, 1938, one week prior to admission had had removed a lower left second molar which had given him pain for about three days. On admission, the chief complaint was severe pain in the left jaw referred to the ear and side of the head, with some external swelling along the body of the mandible extending backward and upward along the ramus in the region of the parotid gland.

Examination revealed that the patient

Fig. 9 (December 26, 1936).—Lower left cuspid region three days after removal of the tooth.

was acutely ill, with a temperature of 102°, but a leukocyte count of only 7,000. Other findings were essentially negative. Intraoral palpation revealed no local swelling in the region of the extracted tooth, but tenderness was evident when pressure was applied in this region.

Treatment consisted of continuous application of hot moist dressings to the jaw, with occasional hot saline mouth irrigations. The fluid intake was increased daily up to 3,200 cc. The pain was so severe that only administration of morphine one-quarter grain "H" gave relief, and then for only a few hours at a time.

January 13, 95 roentgen units was given to the left jaw, 100 PKV, filtered with 1 mm. aluminum for five minutes at a distance of 15 inches.

January 14, twelve days from the onset of pain, a lateral jaw roentgenogram gave no evidence of an osteomyelitis.

January 15, a second dose of 95 R. units was given to the left jaw, external swelling of the left jaw increasing, as well as local pain anteriorly along the body of the mandible in the molar region.

January 16, fourteen days from the onset of pain, with the symptoms increasing in severity, and with the other physical findings, it was evident that the patient had an osteomyelitis of the mandible and that drainage

Fig. 10 (January 8, 1937).—Right lateral jaw roentgenogram of symphysis of mandible, showing early evidence of osteomyelitis (seventeen days from onset).

was advisable. Under light nitrous oxide-oxygen anesthesia, an incision was made through the periosteum along the buccal sulcus from the angle of the jaw forward to the bicuspid region. The periosteum was retracted and a quarter-inch drill hole was made through the external cortical plate. No pus was liberated until the second opening was made. Other openings were made posteriorly in the direction of the third molar region. A vaselin pack was placed in the soft tissue incision.

January 17, a third treatment of 96 roentgen units was given to the left jaw. When I walked into his room, the patient's

only comment was, "I don't know what you did, doctor, but I am better." The white cell count was 11,650, with less pain and temperature.

January 19, three days after drainage was established and seventeen days from the onset of pain, a lateral jaw roentgenogram revealed bone destruction around the area of the extracted last molar on the left side. (Fig. 2.)

January 20, four days after early drainage was instituted, it was evident that better drainage was advisable. At this time, the cortical plate was removed between the openings previously made along the buccal border posteriorly to the ramus, as a posterior extension of the infection was evident. The soft tissue cavity was loosely packed with vaselin gauze to control hemorrhage. An external incision was made for drainage of the ramus.

Fig. 11 (February 14, 1937).—Right lateral jaw; showing extent and location of previous surgical interference.

Fig. 12 (February 18, 1937).—Symphysis; showing marked destruction of bone about apices of anterior teeth.

January 21 and 22 were very comfortable days. The dressings were removed every four hours throughout the day and the wound was irrigated. There was a gradual fall in temperature to normal.

Fig. 13 (May 14, 1937).—Affected area; showing extensive bone regeneration.

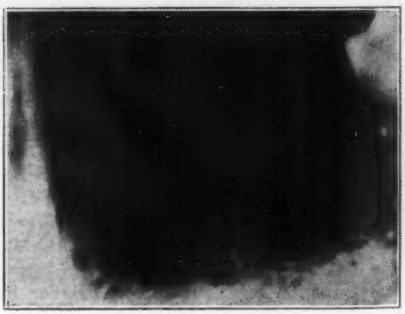

Fig. 14 (October 9, 1939).—Symphysis of mandible; showing complete bone regeneration with no loss of alveolar ridge or adjacent teeth from this method of treatment.

January 23, the patient was dismissed from hospital. Thereafter, home and office treatments were given, consisting chiefly of

changing the drains and irrigating the mouth with normal saline solution.

February 2, the condition was as indicated in Figure 3.

February 16, the patient resumed work (about one month from the onset of pain).

February 22, his condition was as shown in Figure 4.

March 12, the patient was readmitted to hospital, where, under nitrous oxide-oxygen anesthesia, the draining wounds were reopened to improve drainage and to remove a large sequestrum.

Fig. 15 (February 18, 1938).—Lower left second and third molars (twenty-four hours after the onset of pain).

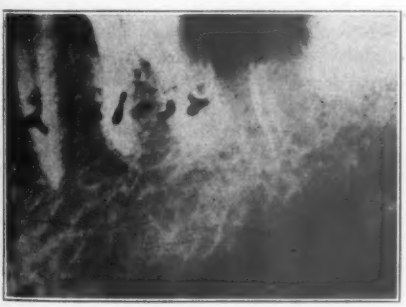

Fig. 16 (February 21, 1938).—Lower left molar region, three days after second molar had been extracted.

May 5, the patient was readmitted for similar treatment. At this time, a large sequestrum from the external border of ramus was removed.

CASE 2.—A woman, aged 46, seen December 26, 1936, in consultation, three days previously had visited her dentist for a check-up prior to leaving the city. A deep pocket was found around a lower left cuspid tooth and the tooth was extracted under local infiltration anesthesia with procaine hydrochloride. The patient, returning home, developed severe pain as the anesthesia wore off. About six hours later, she became ill, with a temperature of 104°. The next morning, she called her physician, who relieved the pain and advised hospitalization. This she refused, but she expressed a willingness to have a trained nurse.

Examination revealed that the patient was

Fig. 17.—Evidence of osteomyelitis of body of mandible in region of extracted lower left molar.

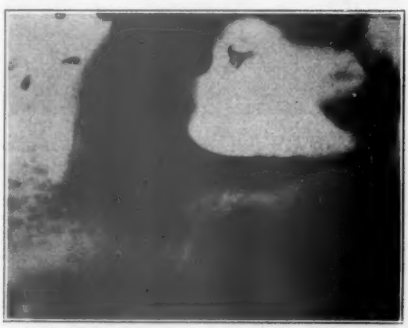

Fig. 18 (April 12, 1938).—Molar area; showing bone regeneration in body of mandible (third molar to be extracted).

very toxic. She had a severe pain in and about the area where the tooth had been extracted. The temperature was 102°. There was no local swelling. Roentgenograms of the region were negative. (Fig. 9.)

A diagnosis of early osteomyelitis of the mandible was not definitely made. The

nurse was instructed to keep hot moist dressings on the jaw in the region of the symphysis, and to use hot mouth irrigations about every hour. Fluids were advised as well as sedatives for the pain.

The nurse reported the patient's condition daily. Four days later, the patient returned for observation. Clinically, there was no change except increasing tenderness and pain in the region of the anterior teeth, with some local swelling of the alveolar ridge extending downward to the labial sulcus. There was no external swelling.

There was no question at this time (seven days from its onset) that this was a case of osteomyelitis of the mandible. This diagnosis was confirmed by the liberation of pus when several openings were made through the labial plate below the apices of the anterior teeth, extending laterally to the cuspid

Fig. 19 (August 16, 1938).—Area shown in Figure 18, after third molar had been extracted.

socket. This procedure was instituted under nitrous oxide-oxygen anesthesia. For twenty-four hours, there was less pain, with a fall in temperature. After forty-eight hours, the pain had again become severe, with a rise in temperature which was indicative of inadequate drainage openings. At a hospital, again under nitrous oxide-oxygen anesthesia, the cortical plate between the openings previously made was removed. There was considerable pus present. The bone cavity was packed lightly with vaselin gauze. On the following day and on January 4, the patient received 100 roentgen units, applied to the chin. The nurse continued to apply the hot dressings. She was instructed, in addition, to remove the gauze, irrigate the bone cavity and repack the cavity lightly.

January 8, 1937, seventeen days from onset and ten days after drainage, the diagnosis of osteomyelitis was confirmed for the first time by a roentgenogram. (Fig. 10.)

Clinically, the infection had subsided. There was almost no swelling, either intraorally or extra-orally. The pain had almost subsided, occurring only when the nurse attempted to remove or reinsert the vaselin gauze. In fact, the patient had refused to have the gauze inserted. She was therefore again anesthetized, the bone cavity was cleaned out, the sequestra being removed, and the cavity was packed.

Daily progress was made from this date on. The moist dressings were discontinued and the nurse had no difficulty in changing the gauze and irrigating the wound.

The patient was seen every second or third day during the month of January. The bone cavity continued to look clean, with definite evidence of bone regeneration. During the month of February, the patient returned twice for observation and an x-ray examination. (Fig. 11.) She returned once during the month of March, at which time she was carrying out her daily routine. (Fig. 12.) May 24, 1937, the condition of the jaw was as shown in Figure 13.

July 29, the four anterior teeth were extracted, as the dentist requested, to facilitate construction of a lower partial denture. A roentgenogram of the lower anterior region (Fig. 14), taken October 9, shows the bone completely healed, with no loss of the alveolar ridge or the adjacent teeth.

CASE 3.—A man, aged 30, referred February 18, 1938, for removal of the lower left third molar tooth, stated that he had had pain for the past twenty-four hours in the region. Removal of the impacted tooth had been advised by his dentist a few hours previously. (Fig. 15.)

From the history and clinical symptoms, it was evident that the source of his complaint was not the impacted tooth. Clinically, the symptoms, chiefly pain, suggested a dying pulp in one of the adjacent teeth. The second molar was suspected for the following reasons: (1) it gave a more active electrical response than did the first molar; (2) it was sensitive to percussion, and (3)

it contained an old occlusal amalgam filling.

The amalgam filling was removed, but no decay was revealed and the pulpal floor was of normal depth. A temporary filling was inserted and the patient was dismissed with sedatives for the pain and with instructions to call if the pain became more severe. This he did, stating that he had had some relief for a few hours, but now the pain was so severe that he wanted the tooth extracted immediately, if possible. The same evening, the lower second molar was extracted under nitrous oxide-oxygen anesthesia with a minimum of trauma.

That night, the patient had some relief, but when he was seen the following day, the pain had returned, more severe than at any time previously. Monday, he gave evidence of toxicity, with general malaise and a fever of 99.6°. (Fig. 16.)

There was some swelling with extreme tenderness in the region of the body of the mandible. With these symptoms and physical findings, osteomyelitis of the mandible was suspected, and the patient was hospitalized the following day.

On admission February 22, the patient had a temperature of 101°, with respiration 24 and pulse 98. His chief complaint was pain in the left jaw, radiating to the ear and side of the head. The fluid intake was increased. Morphine sulfate one-quarter gram every six hours gave considerable relief. Ice bags were applied to the jaw as hot compresses made the pain more intense.

February 23 and 24, the temperature ranged from 99.2 to 102.2°, the pulse from 68 to 96. The white count was 12,200. The Wassermann reaction was negative.

February 24, a one-third erythema dose of x-rays was given to the jaw, 150 K V, and hot moist dressings were applied.

February 26, ten days from the onset of pain, a diagnosis of osteomyelitis was made and the patient was referred to the surgical department. Under nitrous oxide-oxygen anesthesia, an incision was made along the buccal sulcus from the third molar region anteriorly as far as the bicuspid region. The periosteum was retracted and four drill holes were made parallel to the lower border of the mandible and below the apices of the teeth. Considerable pus exuded from the openings. The soft tissue opening was packed lightly to control bleeding.

The patient showed definite improvement for the next few days, with less pain and a lower temperature. The vaselin packing was changed twice daily and the cavity irrigated. This treatment was continued for seven days, when, March 5, 1938, drainage became blocked. Under nitrous oxide-oxygen anesthesia, the outer cortical plate was removed posteriorly to the openings made previously and the sequestra were removed.

March 8, fourteen days from the time of admission and twenty days from the onset of pain, the patient was discharged from the hospital with neither pain nor fever. The soft tissue swelling in the region of the jaw was gradually receding, with no evidence of abscess formation.

March 17, 1938, the condition was as shown in Figure 17.

April 12, 1938, the condition was as shown in Figure 18.

The patient soon resumed work. There were no external scars or deformities.

From these and similar cases treated similarly over a period of ten years, I wish again to emphasize the fact that we should make an early diagnosis and establish and maintain drainage early in these cases if we wish to lessen the extent of the disease and diminish the resultant deformities of the mandible.

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FEBRUARY *Editorial Department* 1941

THE RESPONSIBILITY OF THE DENTIST IN DIAGNOSING SYPHILIS

As illustrative of the broad influence which wars and rumors of wars have on virtually all phases of human activity, we are reminded of the attention that the health authorities of the country are at present directing toward ways and means of guarding against the evils of venereal diseases, which necessarily become dangerous menaces in times when large numbers of troops and industrial workers are quickly concentrated in limited areas.

Each year, in normal times, it has been our custom to offer at least one injunctional editorial in support of the annual national antisyphilitic crusade. This year, however, in addition to the normal need for efforts in this direction, we have the emergency need arising from the exigencies of national defense. Almost overnight, large groups of human beings are being assembled in camps and other areas, and almost immediately the disease potentialities of crowded living conditions express themselves in various natural ways. Among the first of the diseases, contagious in character, to show themselves under these crowded and unnatural conditions is syphilis. And it becomes immediately necessary for

the health agencies to inaugurate ways and means of controlling the sanitary conditions which so definitely influence the incidence of syphilis.

The health professions have done much toward disease control in this field, but the secrecy surrounding the presence of the disease, arising from the social stigma inevitably associated therewith, presents barriers which it is difficult to break down in all instances. Unfortunately, this secrecy is the greatest aid to the spread of this disease menace in human beings; and, unfortunately too, it is necessary to penetrate this veil of secrecy before much can be accomplished toward control of the disease.

In its modern advances, medicine has arrived at the point where there is no great difficulty in controlling and curing the disease if it can be discovered and attacked in its earliest expressions, but it must be in the incipient stages if the victim is to escape, even partially, the serious systemic reactions of this dread disease.

All of us are familiar with the notable work of Ehrlich in his efforts to discover a remedy for syphilis, and even though the results of his investigation led to the discovery of a remedy that is remarkably effective, the very fact that a remedy has been found tends to make the public more careless and neglectful toward the preventive possibilities of the disease, among which may be considered its early discovery, in that early treatment of the disease is a preventive approach. And it is here that the dentist comes upon the scene.

In a large majority of cases of syphilis, the site of first appearance, with the exception only of the genitalia, is the mouth. Since the primary lesions of syphilis appear in and about the mouth consistently, the dentist is in a position, through his care of the masticatory apparatus, to see these lesions in many cases even before the physician does, and the secrecy surrounding the disease greatly increases the opportunity of the dentist to observe manifestations of the disease before the medical man is consulted. It is this opportunity to observe the first expressions of the disease that places the responsibility for diagnosis on the dentist and it also enables the dentist to expand his service to humanity and to assume a greater responsibility in the health service to the community.

From the time of Hutchinson, who identified the syphilitic stigmata in the dentition, the mouth has been looked to as the site of the first expressions of syphilis, both hereditary and acquired. The Hutchinson signs, which are unmistakable, readily lead to the diagnosis of hereditary syphilis; and every dentist who can take advantage of present-day medical aspects of dental education should be able to identify these characteristic signs immediately.

The addition of the internship as an elective feature of dental education should be of material aid in developing a diagnostic ability that will unerringly lead to the absolute diagnosis of not only syphilis but also many other diseases that have distinct manifestations in the mouth and, in some instances, the first manifestations of systemic disturbances.

The importance of strenuous efforts to check the spread of this malady is demonstrated in the antisyphilis crusade which is conducted annually and which has contributed much toward making the nation conscious of the gravity of the menace of syphilis. Each year, a notable group of health workers has conducted these campaigns and has added much to the health effort in general.

The world war "created" another disease of the mouth, so-called trench mouth, which was a source of much distress to the dental profession until we discovered the ways and means of its control. We may expect a recurrent spreading of this disease as the result of necessary gathering of the great groups involved in preparedness activities. While the two conditions are not in any way related etiologically, there is a definite potentiality for evil in the occurrence simultaneously of the two diseases. And this possibility should make the dental practitioner doubly alert to mouth conditions, particularly of the military classes.

The obligation to cope with these conditions hinges on the ability and accuracy with which the dentist examines the mouths of all who come under his care. Intelligent and painstaking examination is the keynote to the situation, and, in this respect, dentists have long been charged with negligence by both the public and the medical profession. In fact, the dental practitioner has long been twitted for failure to see anything beyond the cavity in the tooth. We regret exceedingly to have to admit grounds for such criticism in the period in which the profession was more or less leaning distinctly toward the purely mechanical in dental development. Today, however, since the trend toward educational development from the biologic aspect, there appears to be and there should be no excuse for such a criticism. The dentist of the future, with the educational foundation of a curriculum that has for its motive the inclusion of all of medicine that is necessary for the dentist, with an internship superadded, will have a complete understanding of these relationships between medical and dental practice.

It is axiomatic in medicine that the cause of a disease must be known and understood before a cure can be effected, and it is equally patent that careful examination and intelligent diagnosis must be the means by which one may arrive at a proper knowledge of the etiology. Almost

any physician or dentist is sufficiently familiar with pharmacology to apply the proper medicaments once he is able to diagnose a disease condition, and such knowledge is required in the eyes of the law and expected from the public.

The broadening scope of dentistry, with its closer association with diseases that involve the system generally, obligates the dentist to keep well informed on these relations and equipped to do his part in collaborative treatment of oral conditions that are manifestations of systemic disease. Unless he is thus equipped, the dentist is not qualified either in the eyes of the law or in the eyes of the profession to practice dentistry according to the present-day conception of dental practice as a public health service.

The dentist, for his own protection, must use every means possible to avoid the embarrassments arising from the potentialities for harm in faulty diagnosis, to the patient and to himself physically and to his professional reputation.

THE STATE SOCIETY OFFICERS' CONFERENCE

THE President of the American Dental Association, Wilfred H. Robinson, announces an innovation in the State Society Officers' Conference for its coming meeting, February 16, at the time of the Chicago Midwinter Meeting which should mark the beginning of a new era of usefulness for this conference.

Dr. Robinson offers a program for the coming meeting that will have for its objective complete and thorough familiarization of every state and component society officer with every activity of the American Dental Association.

Beginning with the Sunday morning session, the head of each principal committee, commission, department and activity will present an informatory talk on the aims, purposes and objectives of his particular department. These are to be seven-minute talks and it is expected that each speaker will give an inside view of the functioning of his department.

At the luncheon at noon, each department and activity head will preside at his special table and the guests will be invited to ask questions concerning the activities of the Association. Each host will be expected to answer any and all questions pertaining to his particular activity.

It is expected that the interest thus aroused in the inside workings of

the American Dental Association will act as a dynamic incentive to the accomplishment of the objective of the membership drive—55,000 members for 1941!

The State Society Officers' Conference was organized for the specific purpose of discussing and considering all problems related to the internal workings of the state societies and the parent organization. The impetus toward its establishment and helpful accomplishments was furnished by the late C. R. Lawrence and much good has emanated from the loyal and sincere purposes of those who have guided the activities of this body through the years. The President is hopeful that, with the wholehearted cooperation of those concerned, the February 1941 meeting will set a new "high" for a long series of successful meetings.

Dr. Robinson earnestly requests a large attendance, to the end that organized dentistry may receive an inspirational impetus to speed it on to accomplishments even greater than those enjoyed in the past.

BIBLIOGRAPHICAL

The Fortnightly Review—A New Dental Magazine

THE *Fortnightly Review of the Chicago Dental Society*, the successor of the *Bulletin*, made its official bow to the profession of Chicago January 2, 1941. The review, as the name implies, will be published every two weeks and, from all indications, it promises to be a notable addition to the periodical literature of dentistry.

While the *Fortnightly Review* will devote its energies particularly to the activities of the Chicago Dental Society, an effort will be made to extend its influence into a much broader field of activity. In addition to carrying the reports and news of the regular society meetings and activities, it will enter the more serious field of publication of some of the articles—scientific and otherwise—that are presented at the monthly and midwinter meetings.

The first issue of the *Fortnightly Review* carries a complete program of the coming Midwinter Meeting, embodying literary and clinical presentations on all the latest developments in dentistry.

Particular attention is given to the detailed program of the limited attendance clinics, a comparatively new feature of the Midwinter Meeting and one which offers, not only to the members of the Chicago Society, but also to all members of the American Dental Association, all the advantages of a postgraduate course presenting the latest and best in all phases of dental practice.

The editorial policy and management of the *Review* will be under the direction of the capable editor of the *Bulletin*, Harold Hillenbrand.

We heartily welcome into the field of journalism the *Fortnightly Review* and predict for it a career even more useful and brilliant than that of its predecessor.

The Merck Manual

By Merck & Co., Rahway, N. J. Seventh edition. Cloth. 1,436 pages. Price $2. 1940.

THE Merck Manual, seventh edition, is divided under these topics: therapeutic indi-

cations, poisoning and its treatment, dose table, materia medica, miscellany and index. Of these, the section on therapeutic indications, including the etiology, diagnosis and therapy of a large number of pathologic conditions alphabetically arranged, is by far the largest.

Various diseases of the mouth are described and discussed in the section on therapeutic indications. The oral pathologic conditions for which statements on etiology and treatment are presented are: dental caries, gingivitis, perlèche, ptyalism, pyorrhea and Vincent's angina (infection). In addition, it should be noted that other conditions in which oral symptoms are often prominent are described. Among these are pellagra, granulocytopenia, plumbism, pemphigus and stomatitis. The book also contains a chapter on dentition, including a brief discussion of pathologic dentition.

In general, it appears that the descriptions in this volume are remarkably complete when the wide range of subjects considered is taken into account. Naturally, a great many things cannot be included and, for that reason, the Merck Manual is to be considered a condensation of certain types of information dealing with disease and therapy.

No attempt was made to evaluate the diagnostic and therapeutic portions of the book dealing with problems which are of primary interest to the medical practitioner. The therapy advocated for dental caries is sound in the main. That the use of either sodium perborate or hydrogen peroxide is of established value in this connection cannot be accepted. That the treatment of pyorrhea is largely in the dentist's hands is agreed. Very tentative suggestions are made concerning diet and this is proper in view of the dearth of exact information on this topic. Others probably cannot place so much confidence in the efficacy of potassium chlorate in the treatment of "pyorrhea" and gingivitis as the author apparently does. There may be a fairly good basis for the use of this drug in mercurialism, but it does have toxic potentialities. Suggestions for the treatment of Vincent's infection are essentially sound. There appears to be too much confidence placed in the efficacy of oxidizing agents and the efficacy of arsenicals administered intravenously and intramuscularly. Among the additional remedies for Vincent's infection is potassium chlorate, given locally and internally. The former is of unproved value and the latter dangerous and probably useless.

In brief, it may be stated that the information of primary interest to dentists is well presented, but changes, and particularly deletions, would be helpful.

The sections on poisoning and treatment, dose table and materia medica are interesting and worth while, although no apparent attempt has been made to evaluate the usefulness of the drugs described in the section on materia medica.

From Pioneer to Scientist

THE LIFE STORY OF GREENE VARDIMAN BLACK, "FATHER OF MODERN DENTISTRY," AND HIS SON, ARTHUR DAVENPORT BLACK.

By CARL ELLSWORTH BLACK and BESSIE MCLAUGHLIN BLACK, Jacksonville, Ill. Cloth. 498 pages, an appendix and an index of 94 pages. Illustrated. 1940. Price $3. Bruce Publishing Co., St. Paul.

HERE, for the first time, is presented a complete detailed picture of the Blacks—G. V. and Arthur D.—and the story of their development and their influence on dental science and dental art. Beginning with the family background, a detailed account is given of the early life of Greene Vardiman Black, the "Father of Modern Dentistry." His problems as a boy should offer encouragement to those having to deal with "difficult" youngsters. It is surprising to realize that G. V. Black was almost entirely self taught. He had none of the advantages of collegiate or university training, and all the academic recognition that he later received was honorary, in compensation for the many contributions that he made to science and dental practice. It is evident that once G. V. Black "found" himself in dentistry, a field which could occupy both his intellectual and his mechanical talents, he threw himself enthusiastically into dozens of investigations, an activity that was to continue unabated for over fifty years and completely change the complexion of dental practice and the place dentistry occupied in the health field. The wide range of interests, the broad scope of his vision and his continued industry are manifested in the number and variety of his

publications. It may also be said that here for once was a man who was genuinely respected and admired during his lifetime by his contemporary workers. This attitude is reflected by the number of G. V. Black study clubs and testimonial banquets and other honors showered on this distinguished worker.

Arthur D. Black held a hardly less conspicuous place during his lifetime. Being intimately associated with his father throughout his lifetime, he carried on the work where "G. V." left off. Together, the two of them accounted for a service of more than thirty-five years as deans of the Northwestern University Dental School, and it was largely through their influence that the school assumed a leading rôle among dental educational institutions. Arthur D. Black, in some respects, had a difficult rôle in life to fulfil. To be the son of a brilliant father often offers unusual difficulties in developing an individual personality and reputation. Yet Arthur accomplished these things and added luster to the Black reputation by his own contributions to dentistry. This volume should prove of great interest to old-timers in dentistry for the feeling of nostalgia it creates in discussing the "good old days" of dentistry. For youngsters in the profession, it will be inspirational as indicating what a man and his mind can do if he will couple hard work with inherent ability.

Food, Teeth and Larceny

By CHARLES A. LEVINSON, D.M.D. Cloth. 232 pages. Price $3. 1940. Greenberg, Inc., New York, N. Y.

THE problem of handling insurance claims for those who allege to have broken or injured their teeth or other structures of the mouth because of foreign bodies in their food is described in this new book by Dr. Levinson. The rôle of the insurance dentist in these cases, how he proceeds in his examination, the information he looks for, proper court procedure and other technical details are described. This volume should prove to be of interest to those of both the legal and the dental profession who are engaged in this aspect of insurance work.

Twelve Periodontal Studies

By HAROLD KEITH BOX, D.D.S., Ph.D., Research Professor of Periodontology, Faculty of Dentistry, University of Toronto, 1940. 251 pages. Price $2.50. The University of Toronto Press, Toronto.

THIS small book contains an edited series of lectures presenting a comprehensive survey of the basic principles of periodontology. The contributions of Dr. Box to periodontology are reported here, as well as the recent work reported by other investigators. Each chapter or study is preceded by an outline. Thus, one is able to quickly summarize each chapter. An adequate bibliography follows each chapter. The first half of the volume deals with the biologic factors of importance in the understanding of periodontal pathology. Here, one finds an exposition of the effects of occlusion, wear and traumatic occlusion as well as lack of function, on the periodontal structures. The second half of the book deals with periodontal therapeutics, and here the management of various periodontal lesions is discussed. There is much of a thought-provoking nature in this book. The work done by Dr. Box is well known, and his position in the field of periodontology is further strengthened by this interesting volume.

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President's Page

Fellow Members of the American Dental Association:

NOW that the holidays are over and 1941 has been ushered into our plan of thinking, most of us find ourselves finishing up the tag ends of the Old Year's business. January has given us time to attend to details that were left out of consideration during the Christmas rush. It has allowed us a breathing spell in which to reflect on the heartening progress and the many accomplishments of the American Dental Association during the past twelve months.

Turning our thoughts again to the year ahead, we see promising vistas expanding before us. Somehow we are inclined to believe, at this time of year, that, though rain and sleet keep their usual pace with the calendar, the proverbial spring sunshine is just beyond the horizon. It gives encouragement, inspiration and promise of growth to "all things of the earth." Accordingly, we are enabled to envision the carrying out of plans by our organization which will also share in the development and growth of this New Year. We perceive rising out of the untrodden paths of the coming months new problems to be considered and solved, with new channels branching out and new objectives to be attained amid the increasing cooperation and endeavor of our members.

STATE SOCIETY OFFICERS' CONFERENCE

That which attracts our immediate attention and which will inaugurate our manifold program for the year is the State Society Officers' Conference, to take place February 16 in Chicago. We are hopeful that each state will be represented by a full and enthusiastic delegation. During this conference, vital problems concerning the welfare of dentistry will be discussed.

The conference will also establish a new method of procedure. After each paper, thirty minutes will be allotted for a period wherein the visiting members may not only discuss the views presented, but also bring before the assembled state officers similar perplexing problems confronting them in their own state associations. This debate will afford a thorough review of the problems under consideration, as well as an opportunity for many constructive suggestions regarding those problems, and their ultimate solutions.

Assembling in the morning, the conference will open with ten-minute reports by the heads of the departments within the Central Office and by the chairmen of all standing committees of the American Dental Association. The subjects presented will relate to the activities within the various departments and to the problems confronting the standing committees and the effect of these problems on the dental profession.

At the luncheon following the morning session, tables will be presided over by representatives of the Association, which will include the officers, the members of the Board of Trustees, the committee chairmen and the departmental heads. Luncheon guests will be invited to ask questions concerning the scope and work of the Association, which will be answered by the presiding hosts.

The papers planned for the afternoon meeting are: "Refresher Courses" by Raoul H. Blanquie, of California; "State Membership" by George W. Matthews, Alabama; "State Legislation" by F. J. Henry, Michigan, and "Economics" by John W. Cooke, Massachusetts.

The meeting will conclude with a discussion of individual state problems, which will be considered in open forum.

The enthusiasm and zest which are expected at the conference should send the state officers home to continue with new vigor the work within their associations and fully resolved to bend every effort toward reaching the membership goal of 55,000.

THE JOURNAL

THE JOURNAL, the official medium of publication of the American Dental Association, each month goes to a membership of nearly fifty thousand; to a junior membership of 1,900, and to a foreign subscription list of about 2,000. Each month, more than 57,000 copies carry to the members the most recent dental literature, presented in attractive illustrated form, covering scientific developments in dentistry; editorials dealing with the pertinent issues before the profession, and reports of the activities of all the various commissions, committees and departments of the Association.

THE JOURNAL comprises in essence a complete and comprehensive postgraduate course in up-to-date dental practice, covering every phase of dentistry, and if the alert member will follow studiously the content of THE JOURNAL, he will be assured of keeping pace with the developments and advancements in dental progress.

THE JOURNAL has inaugurated the policy of presenting each month in its Association Activities Department a more or less complete review of the numerous activities of the Association.

THE RELIEF COMMISSION

The Relief Commission announces an increase of nearly 15 per cent in the seal contributions to the Relief Fund during the Christmas season. Since November 15, five new applications have been completed for members in four states. Eight other applications have been mailed to as many states. Payments during December, totaling between $1,400 and $1,500, were divided among forty recipients.

THE COMMITTEE ON DENTAL ECONOMICS

The Committee on Dental Economics is studying the possibility

of making a survey of dental incomes annually or biannually beginning with the incomes of 1940. In 1932, the American Dental Association made an extensive study of this subject as a part of its cooperative work with the Committee on the Costs of Medical Care. Those figures showed that the average dental income in 1929 was approximately $4,000. Since that time, most of the surveys have been made by the Department of Commerce as part of its work of determining the national income. In 1933, the average dental income was $2,251; in 1935, $2,536, and in 1937, $2,914. Reliable information on the average income since then is not available, and the Committee on Dental Economics believes that it should be determined regularly and accurately.

THE COUNCIL ON DENTAL EDUCATION

The Council on Dental Education released its statement of "Requirements for the Approval of a Dental School" in December. These requirements were also printed in pamphlet form and distributed by the Council to the Officers, Trustees, committee chairmen and 1940 House of Delegates of the American Dental Association; to deans of dental and medical schools and to state and provincial dental examining boards in the United States and in Canada, to college presidents and liberal arts college deans interested in both preprofessional and professional training; to various accrediting agencies, and to federal and state educational administrative officers. The Council will begin the inspection of dental schools which seek its approval with the opening of the academic year 1942-1943.

The next important undertaking of the Council will be the congress on dental education and licensure to be held at the Stevens Hotel in Chicago, Saturday, February 15, 1941, the full program of which appears in this issue of THE JOURNAL. Invitations have been extended to dental and medical faculties and to dental examining boards in the United States and in Canada. All dentists attending the Midwinter Meeting of the Chicago Dental Society are invited to attend the congress. *The Journal of Dental Education,* published by the American Association of Dental Schools, plans to publish all the addresses given at the Congress in its February issue.

These summaries of several of the Committee activities testify to the comprehensive and varied scope of the American Dental Association and to but a few of the advantages to be derived from membership. We are confident that the ensuing year will broaden the aim and achievements of our organization and bring us closer to our established goals.

Wilfred H. Robinson.

BUREAU OF PUBLIC RELATIONS

A UNIQUE PLAN FOR ATTACKING THE DENTAL HEALTH PROBLEM IN SECONDARY SCHOOLS

By Irwin Walter Scopp, B.S., D.D.S., New York, N. Y.

THE PROBLEM

DENTAL care for highschool and vocational school children is definitely inadequate. The ravages of dental decay are most pernicious during childhood and adolescence. It has been estimated, through many reliable channels, that at least 80 per cent of school children are in need of dental care. At the Metropolitan Vocational High School, the percentage is slightly higher. For example, if ten children were taken from a classroom and examined by a dentist, eight would need remedial and preventive dental treatment and only two would have healthy mouths.

If we recognize health as one of the aims of education, an oral health program needs no defense. The child sorely needs training in oral health care. The lack of training available to growing children has been one of the weakest links in the chain of sound health. Only by augmenting and amplifying a sound program can oral health and consequently systemic health be maintained.

THE PROGRAM

In the education of the child in oral health, a four-fold program should be carried out:

1. Formal dental health education, both in the classroom and in the dental chair in school.
2. Examination of all students in the school clinic.
3. A reparative dental program in the school for indigents.
4. A preventive dental program in the school for indigents.

The manning of such a program should be under the direction of the department of health education in each school. A dentist who is also a teacher of health education should be in charge of the program.

PERSONNEL

This dentist-health education teacher combination is effective. With his training in pedagogy, the teacher should be able to present oral health interestingly and effectively. With his training as a dentist, he should do dental work of a preventive and reparative nature right in the school building on those students unable to afford private dental care.

THE SERVICE RENDERED

The preventive and reparative program for those who cannot afford private service should be complete. This means examination, prophylaxis, fillings of amalgam and porcelain and the supplying of missing teeth where essential to mouth efficiency, speech and the appearance. Extractions should be referred to local hospitals, where they can be done gratis. The provision of dental care for those unable to pay can be justified if we realize that none is available for indigents beyond the 4B grade.

Private practitioners are safeguarded, since reparative work is done only on those who cannot afford private service.

This rule must be strictly adhered to if we do not want the opposition of organized dentistry. The official teacher probably knows her class best and can decide who is entitled to free care or reduced fees. At the Metropolitan Vocational High School, the adviser, who is the student's counselor throughout his high-school career, certifies the child's inability to pay. The scheme has worked out satisfactorily at this school.

Actually, however, the private practitioner is benefited. Because of the periodical oral examination administered by the school dentist to all students, many are notified of dental defects that might otherwise have passed unnoticed. Furthermore, in oral hygiene lessons, they are taught the value of periodic visits. In short, the student learns that good oral health comes only through scrupulous care. Those students able to afford dental care will flock to the private practitioner. As a practitioner of dentistry, I have found that many students go to a dentist only upon compulsion by their hygiene teacher.

At Metropolitan Vocational High School, we have a scheme that approaches the ideal. Here, we have a dentist appointed by the board of education. Students assist at the chair in the clinic and receive a course in dental assisting as part of their shop work. The dentist makes examinations and gives prophylactic, operative and prosthetic service to the students of the school who are referred as indigent or semi-indigent by their adviser. All other students are examined and sent to their family or neighborhood dentist for reparative dentistry. When his work is completed, the student is required to present a letter certifying that his mouth is in good order. Many hundreds of letters are on file to this effect, and, incidentally, this is further evidence that the private practitioner benefits from such a program. In the dental chair and in the classroom, the student is taught the value of oral health, and how it is obtained. The small fees collected are used to purchase supplies. The deficiency in the scheme, however, is the fact that not enough of the children are reached, since the clinic operates only two periods a day.

The above-outlined program has worked smoothly and without objections from any source. The children have benefited materially in health. It is my belief, therefore, that each school should have a dentist-health education teacher, regularly appointed by the board of education, to administer a program of oral hygiene. This dentist-health education teacher can adapt his program to meet the needs of the individual school.

240 East One Hundred Seventy-Fifth Street.

STREAMLINING AND DENTISTRY

By MILLARD D. GIBBS, D.D.S., Hot Springs, Ark.

STREAMLINING is the answer to the demands for more speed and the term has come to be allied with modern trends and progress. Dentistry, definitely having a part in the progress that has been made between 1840 and 1940, can be classed as a profession of streamlined proportions.

Dentistry is face to face with a new century and, in the profession, ideas both theoretical and fantastic will, like a pendulum, swing from one extreme to another. Some will prove practical, while others will be discarded. At the close of its first century as an organized profession, dentistry has many outstanding ac-

complishments to its credit. Will the second century see a continuation of the progress of the first, or will the profession become stalled in the mire of self-satisfaction?

Business at the close of each year takes an inventory. Why should not dentistry at the close of a century make an inventory of the service that it could have rendered, but was denied the privilege of performing because of lack of recognition or failure to be given a part in programs dealing with health?

Dentistry, like the medical profession, should have individuality, that its usefulness in all programs having to do with health may be more keenly appreciated. Take the selective draft now in progress: those of us who are serving on draft boards are classified as members of the medical boards. We have the Army Dental Corps and the Naval Dental Corps: why not individual dental draft boards?

Life, health and accident insurance companies are among the organizations that give full recognition to the medical profession in physical examinations of applicants and policy holders. They have their medical directors and also medical examiners in every locality large and small, but seldom consider dental examiners necessary to their efficiency. Why fill every age class with dental cripples, with the result that policy holders receive reduced dividends? Dental examinations and corrective dental treatment would largely prevent this.

To my effort to awaken insurance companies to the importance of dental examinations among those whom they serve, which was first presented in the May 1932 JOURNAL, there has been much favorable reaction. The Academy of Dentistry, Toronto, Canada, has gone into the matter of dental examinations by insurance companies in a determined manner, and as a result, the Canadian Dental Association has become interested in the idea. On several occasions, upon request, I have supplied the organizations with material on the subject.

The American Dental Association left the matter with the Insurance Committee of the Association, of which A. W. Weakley is chairman and Fred A. Richmond, secretary. C. N. Johnson supported the idea editorially in the May 1934 issue of THE JOURNAL.

Such reaction makes it obvious that, with a determined crusade, dentistry can be made an important factor in many health programs in which at present it has no part. There are some state boards of health whose officials have seen the advisability of adding a dentist to the personnel of the board. This should be universal.

Counties, cities and towns throughout the country in a great majority of instances either elect or appoint medical men to serve as health officers. Would it prove an aid or a hindrance if counties, cities and towns were to include a dental health officer as a definite part of their health personnel? This failure to include dentistry in health care is indicative of the laxness that prevails in many sections of our country regarding much needed dental service.

Even among people who have been informed as to the importance of looking after children's teeth, we encounter appalling negligence regarding the much discussed first permanent molar. Not only is such neglect costly in teeth and tooth structure, but it tends as well to undermine the child's health. Yes, it is most apparent that dentistry should have a part in every health campaign. Children's dentistry has always been important, but, in more recent years, dentistry has become cognizant of this fact, and now that the dentist's responsibility to the child has been fully realized, let dentistry, through its individual practitioners, strive in every way possible to see that dentistry is given its rightful place in the battle for supremacy against disease.

Another avenue of service which our

profession has failed to recognize is that concerning railroads and lines of transportation. Nearly every one of these carrier systems designate medical men to care for the sick or injured of not only passengers but also all employes. These organizations that maintain hospitals do appoint a dentist to the staff in some instances.

Dentistry's progress during its first century was not alone in material and mechanics: it made marked strides in the matter of public health. So great has been that progress that no organizations having to do with health can be considered 100 per cent progressive if they ignore dental care.

We as a profession, if we would serve more people, must in a determined manner seek recognition among the abovementioned groups.

When, from out of our first century as an organized profession, we emerge, we are met with the startling figures that approximately only 25 per cent of the population of the United States ever visit a dentist. Filling the gaps in dental recognition can certainly change that deplorable situation. There are perhaps other causes for failure of such a large percentage of our population to seek or receive dental care. One may be due to a desire of the graduates of our dental schools and colleges to locate where the lights are brightest rather than in smaller, agricultural and industrial centers.

Educational publicity has done much in continually striving to inform the public regarding the importance of dental care. The Selective Service should eventually educate thousands of young Americans regarding the importance of dental health.

Philanthropists like Guggenheim, Eastman, Kellogg and Forsyth have done much to promote dental knowledge and dental service. That others shall follow the lead of such philanthropists is much to be desired.

The following quotation from the *Journal of the Illinois Dental Society* describes dentistry as it should be: "The ultimate accomplishment of the dental profession should be the establishment of dental service as a health service and the dentist as a counsellor of advice rather than the purveyor of devices." Billings, Hunter, Rosenow, Haden and many others have done research which assured a definite place for dentistry in the health picture.

With an excellent background in the field of research, dentistry must continue to go forward, holding every line, that the goal of complete recognition of dental health service may be reached.

There should be no detours for dentistry on the highway of progress if it is to make greater headway in its second century. With our profession alert, greater speed will be made in filling the gaps; and with our individual contacts and influence, we can emphasize this thought: Dentistry must have a part in every health program if the public health is to be best served.

A NEW DENTAL EDUCATIONAL BOOKLET: YOUR CHILD'S TEETH

THE Bureau of Public Relations announces the publication of a 44-page booklet on the care of children's teeth. Its authors, Vivian V. Drenckhahn, M.S., C.P.H., and C. R. Taylor, D.D.S., M.S.P.H., of the W. K. Kellogg Foundation, have taken infinite pains to make its contents both authoritative and understandable. It has sixty illustrations, forty of which are photographs by Robert T. Coleman of the Kellogg Foundation of actual cases, and its cover is a beautiful four-color reproduction of one of Mr. Coleman's best kodachrome prints.

Fig. 1.—Parents can make it possible for children to develop habits of self-care by providing convenient equipment.

This booklet, as stated in the foreword, has been prepared by the Bureau of Public Relations of the American Dental Association for parents and teachers of children from the preschool age through the elementary school age group. It describes the growth of teeth from the third month of prenatal life through the time of eruption of the permanent teeth, indicating the important relationship of dental health to the child's development.

Fig. 2.—The dentist explains the use of the various instruments in order to gain the child's confidence and to prevent fear. Here the child is becoming acquainted with the mouth mirror.

Fig. 3.—Dental caries between the teeth. (Patient aged 6 years.)

"Your Child's Teeth" has been approved by the Committee on Dental

Health Education of the American Dental Association and by the U. S. Public Health Service.

Fig. 4.—When injured by accidents, the teeth should be cared for immediately by the dentist. The large central incisor to the left in the picture has been temporarily protected, and the other is about to receive similar treatment.

Every dentist will want copies for his waiting room and for the parents of his child patients. Teachers and health workers will also find it of the utmost value.

The price: 10 cents per single copy; 50 copies, $4.50; 100 copies, $8.00; 500 copies, $35.00, and 1,000 copies, $60.00. Address the Bureau of Public Relations, American Dental Association, 212 E. Superior St., Chicago, Ill.

Fig. 5.—X-ray picture at age 13, showing all of the permanent teeth in position except the third molars, which are shown (8) still under the gums. These teeth usually erupt between the ages of 17 and 21 years.

SECOND GRADE DENTAL EDUCATIONAL LEAFLETS

Six leaflets designed for first or second grade dental education. Each lesson is printed on 8 x 11 inch drawing paper. The wording is fitted to the second grade vocabulary. The text is scientifically correct. The drawings are simple and artistic. After each lesson is learned, the drawings are to be colored by the child. They enable educators to coordinate the teaching of dental health with that of art and of reading.

Tell your school authorities about them. Use them in your office to entertain children while they are waiting in the reception room.

One set of six leaflets, 5 cents. Twenty-five sets of leaflets, 50 cents.

Bureau of Public Relations, American Dental Association, 212 East Superior St., Chicago, Ill.

MILK
Milk helps to build strong teeth.
I drink milk with my meals.
I eat milk on my cereal.
I eat cereal and milk for my breakfast.
I like bread and milk.
My teeth need milk to help make them strong.

CLEVELAND CHILDREN'S DENTAL HEALTH DAY

THE Cleveland Dental Society has arranged an outstanding program for "Children's Dental Health Day," February 3, which will focus public attention in the Cleveland area on the contributions made by dentistry to its preventive phases.

In addition to a day-long program of lectures, clinics and exhibits for the profession, the quintuplets' dental health record—a highlight in the Hall of Exhibits during the A.D.A. Convention in Cleveland in September—will be on display at the Cleveland Health Museum from January 27 to February 3. Arnold D. Mason, dean of the University of Toronto, who has been responsible for the quintuplet's dental health, will lecture to the public February 2 and will also be the principal speaker at the luncheon meeting February 3.

In arranging "Children's Dental Health Day," the Cleveland Dental Society is making a direct contribution to one phase of the program adopted at the recent national convention for the second century of dentistry. This three-point program included research, preventive dentistry and care of the indigent.

Cleveland also has a special interest historically in children's dentistry, since the first public school dental program, the Ebersole Experiment, was a Cleveland project. Preventive dentistry programs in communities throughout the nation stemmed from this experiment.

All sessions of the meeting will be held at the Hotel Statler. The program follows:

Children's Dental Health Day
Monday, February 3, 1941
Sponsored by
The Cleveland Dental Society
To focus attention on the importance of children's dentistry.

Morning Session

9:00 "The Economics of Children's Dentistry"
John C. Warnock, Professor of Economics,
Kansas City-Western Dental School,
Baldwin City, Kan.

10:00 "Dentistry for Children—Clinical Procedure Versus Private Practice (Can You Accomplish Something for a Child Patient in Twenty Minutes?)"
Theodore C. Blutau,
Rochester, N. Y.

11:00 "Dentistry for Children" (1500-foot movie film in full color)
John C. Brauer, Professor of Children's Dentistry,
University of Iowa Dental School,
Iowa City, Iowa.

12:15 Luncheon meeting
"The Dental Conditions of the Dionne Quintuplets"
Arnold D. Mason, Dean, Dental Department,
University of Toronto,
Toronto, Canada.

Afternoon Session

2:00 Table clinics and health exhibits

4:45 "How to Handle Local Anesthesia for the Child Patient"
James N. Gasoway,
Detroit, Mich.

6:30 Dinner meeting
"How You Can Help Yourself by Helping Children"
John C. Brauer,
Iowa City, Iowa.

COUNCIL ON DENTAL THERAPEUTICS

DR. PAUL NICHOLAS LEECH
(1889-1941)

PROGRESS in the medical sciences, in the arts, in social sciences, in all worthwhile human activities represents the accumulation of contributions of men of high character. When high character is combined with energy, astuteness, thorough training and kindliness in the same man, we may anticipate from him lasting contributions to social welfare. Such a man was Dr. Paul Nicholas Leech, Secretary of the Council on Pharmacy and Chemistry and Director of the Chemical Laboratory of the American Medical Association.

Through his numerous contributions to scientific and rational medication and through his helpful interest in the work of the Council on Dental Therapeutics, Dr. Paul Nicholas Leech has made a lasting contribution to dental science. It was he who trained the first chemist of the American Dental Association Bureau of Chemistry. It was he who aided in the establishment of the Council on Dental Therapeutics. It was he who continued to the time of his sudden death to share with us freely his abundant store of knowledge and to give us the benefit of his advice. In return for all this, Paul Nicholas Leech asked nothing for himself.

This Council mourns the passing of a most distinguished scientist and friend. His contributions to truth, honesty and efficiency in therapeutics, his gifts to medicine, to dentistry and to the public form a monument to his memory which neither time nor change can obliterate or deface.

THE VITAMIN B COMPLEX

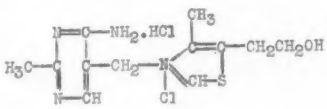
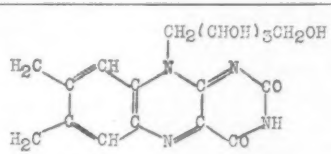
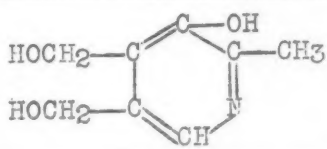
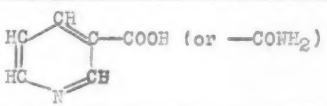
THE following report, prepared by a Council referee, has been adopted by the Council and authorized for publication as one in a series of articles on pharmacology and therapeutics.

HAROLD L. HANSEN, *Secretary*

The term vitamin B complex is applied to a group of chemically distinct, water-soluble substances of nutritional and physiologic significance. Illustrative of the rapid development in this field is the fact that a few years ago only two members of the group were recognized.

This brief survey of the members of the vitamin B complex is presented because of the general interest in and importance of nutrition in dentistry. The number of inquiries, both general and specific, which the Council has received during the past year is indicative of a commendable interest in the problems of nutrition and dental health. Elsewhere,[1] the Council has pointed out in effect that widespread application of information on nutrition in the treatment of dental conditions should await the presentation of adequate evidence to warrant such procedures. On the other hand, it seems almost self-evident that those nutritional factors which are of importance to general health and to the prevention of vitamin-deficiency diseases also have a bearing on dental health. This suggests the value of a broad interest in nutrition on the part of the dentist and of a knowledge of those vitamin-deficiency diseases the signs and symptoms of which appear, in part at least, in the oral cavity.

The exact number of constituents in the vitamin B complex is unknown. Those which are contained in the accompanying table have been the subject of reports in the literature. are now listed and described in the U. S. Pharmacopeia. Evidence of the necessity or desirability of other factors in human nutrition, such as vitamin B_6, has been presented. Some of this evidence is still

Vitamin	Structural Formula	Deficiency Symptoms	
		Human	Experimental Animals
Vitamin B_1 Thiamin Thiamine hydrochloride		Beriberi	Polyneuritis
Vitamin B_2 Riboflavin		Cheilitis Possible growth disturbance	Growth disturbance in chicks and rats; cataract in rats.
Vitamin B_3			Impaired nutrition of pigeons
Vitamin B_4			Paralysis in rats and chicks.
Vitamin B_5			Loss of weight in pigeons
Vitamin B_6			Dermatitis in rats.
Filtrate factor (Pantothenic acid)	$CH_2OCH(CH_3)_2CHOHCONHCH_2CH_2CO_2H$		Nutritional dermatosis in chicks.
Factor W			Growth disturbance in rats.
Nicotinic acid		Pellagra	Black tongue in dogs

Of these vitamins, the following have been shown to be necessary in human nutrition: riboflavin, nicotinic acid and thiamine hydrochloride. The last two unconvincing or vague. This does not mean, of course, that future evidence on these other factors, some of which may now be unknown, may not be as clear-

cut and decisive as that now existing for thiamine hydrochloride.

THIAMINE HYDROCHLORIDE—VITAMIN B_1

Thiamine hydrochloride, first isolated in 1927, is now being prepared synthetically. It is of value in the prevention and treatment of beriberi. There is also evidence that it is of value in securing optimal growth of children and in the treatment of anorexia of dietary origin in some cases. There is also evidence of the value of thiamine hydrochloride in the treatment of conditions described as neuritis of pellagra, neuritis of pregnancy and alcoholic neuritis. "Vague representations with respect to the value of thiamine in the treatment of other types of neuritis are not permissible."[2]

Bakhsh[3] reported that thiamine hydrochloride had proved of value in the treatment of trigeminal neuralgia. Six of seven cases were reported to have shown improvement ranging from 100 (in four) to 30 per cent. On the other hand, Aring, Evans and Spies[4] reported that six patients suffering from severe pain (carcinoma, cord tumor and brachial and trigeminal neuralgia) obtained no relief from pain with daily intravenous doses of the vitamin over a period of ten days.

Strauss,[5] Jolliffe,[6] Cowgill[7] and others have pointed out that vitamin B_1 deficiency in this country is more widespread than has commonly been supposed. Apparently, a large fraction of the population subsists on diets which are at best on the borderline of adequacy with respect to vitamin B_1. Fortunately, the means for overcoming this deficiency are not out of reach. The referee believes that the policy of the Council on Foods and Nutrition of the American Medical Association is worthy of serious consideration in this connection:

> The Council on Foods desires to encourage the restorative addition of vitamins or minerals or other dietary essentials, in such amounts as will raise the content of vitamin or mineral or other dietary essential of general purpose foods to recognized high natural levels; with the provision that such additions are to be limited to vitamins or minerals or other dietary essentials, for which a wider distribution is considered by the Council to be in the interest of the public health.—Accepted Foods and Their Nutritional Significance, p. 6.

Obviously, restorative addition of vitamins to staple foods is only a part of the necessary program. Education of the public, in which the dental profession can play an important part, is essential.

NICOTINIC ACID AND NICOTINIC ACID AMIDE

Nicotinic acid is a valuable therapeutic agent in the treatment of pellagra. It is recognized as a specific only in the treatment of acute pellagra.

On the basis of favorable results obtained in the treatment of canine "black tongue," Elvehjem, Madden, Strong and Wooley[8] suggested that nicotinic acid and nicotinic amide be tried clinically in human pellagra. Experiments of this nature were carried out by Fouts *et al.*[9] and Spies *et al.*[10] These workers and others have found that administration of nicotinic acid has dramatic results in many cases of human pellagra. This includes rapid improvement of the fiery red, swollen mucous membrane. Spies *et al.* reported that the pellagrous glossitis, stomatitis, ptyalism, vaginitis, urethritis, and proctitis did not reappear while their patients received nicotinic acid. It has been noted, however, that nicotinic acid is without influence on the polyneuritis so often observed in pellagrous patients. In these cases, administration of foods rich in vitamin B_1 or administration of thiamine hydrochloride is essential. This is a rather striking, but not unexpected indication of the fact that vitamin deficiencies in the B group may be multiple.

Mead[11] and Kirkland[12] have described the oral lesions commonly seen in pellagra. The latter has pointed out that while the treatment of the pellagrous condition does not come within the

sphere of dentistry, the dentist is often the first one consulted.

The possible relationship between pellagra and Vincent's infection has been discussed by several investigators. Mouth lesions in monkeys due to dietary deficiency in nicotinic acid have been reported by Tomlinson[13] and by Toppins and Fraser.[14] Prior to this time, many studies had been conducted on canine black tongue, a dietary deficiency disease the investigation of which has been of fundamental importance in the study of pellagra. In this connection, it is interesting to note that Smith, Persons and Harvey[15] found secondary fusospirochetal infection in dogs with the Underhill syndrome as well as in dogs with the Goldberger type of black tongue. The former syndrome may be prevented by inclusion of adequate amounts of cod-liver oil in the diet.

Spies[16] has found that nearly all patients with severe pellagra of the oral cavity have a secondary, but extensive infection with Vincent's organisms. King[17] reported the successful treatment of Vincent's infection in four cases by administration of nicotinic acid. These and other reports indicate that dietary deficiencies, including that of nicotinic acid, have a bearing on the development of Vincent's infection. It is well to note, however, that many other conditions, including mechanical, metabolic or toxic, may result in a predisposition to Vincent's infection. In a general review of the problem of predisposition, Rosebury[18] has considered the various known or suggested factors in Vincent's infection.

In a preliminary report, Miller, Greenhut and Roth[19] stated that the use of large doses of nicotinic acid in ten cases of acute Vincent's infection failed to have a beneficial effect. They also pointed out, as has been done elsewhere,[18] that the mouth lesions of patients with nicotinic acid deficiency are not the same clinically as those of patients suffering from Vincent's infection.

RIBOFLAVIN

It is now known that riboflavin is essential in human nutrition. Of particular interest to dentists is the fact that dietary deficiencies of riboflavin may produce a cheilitis. This cheilitis, which occurs frequently in endemic pellagra, has been considered an accessory sign of the pellagrous syndrome. At one time, it was known as marginal stomatitis. The lesions are red. Desquamation and finally ulceration of the lips at the mucocutaneous junction occur. Fissures or rhagades may be present at the corners of the mouth.

In well-controlled studies on human subjects, Sebrell and Butler[20] demonstrated that the lesions mentioned above are a manifestation of riboflavin deficiency and that they can be alleviated or prevented by administration of synthetic riboflavin. Similar results were obtained in a clinical study by Sydenstricker, Geeslin, Templeton and Weaver.[21] Cheilitis may develop while oral and neurologic manifestations of pellagra respond to treatment with nicotinic acid.

HUMAN REQUIREMENTS FOR THIAMINE HYDROCHLORIDE, NICOTINIC ACID AND RIBOFLAVIN

The human requirements for vitamins vary in accordance with size, caloric intake, type of diet, state of health and other conditions. Illustrative of the influence of health on vitamin requirements is the recent report by Bean and Spies[22] on vitamin deficiencies in diarrheal states. In one case reported by these investigators, the signs of deficiency disease disappeared with control of a diarrhea.

In consideration of the daily requirements of vitamin B_1 for normal human subjects, Cowgill[23] has suggested that the vitamin intake be based upon the caloric intake. Vitamin B_1 is now believed to play a rôle in the metabolic transformation of carbohydrate in the body. On this basis, it has been suggested that

10 international units per hundred calories affords a minimum satisfactory intake. Rose[24] has suggested the equivalent of 15 international units. For the average adult, this would amount to from 250 to 400 international units. The international unit represents 3 micrograms of thiamine hydrochloride. It has been suggested that the optimum for young children and lactating women is higher than the figures given above. From 20 to 25 international units per hundred calories has been proposed.

Estimates of the daily requirement of riboflavin are somewhat variable. It has been suggested[25] that 600 Sherman-Bourquin units provides a reasonable margin of safety for the average normal adult. One Sherman-Bourquin unit is equivalent to about 3 micrograms of riboflavin.

Apparently, the daily requirement of nicotinic acid has not been fully determined. Prevention of recurrence of pellagra has been accomplished by supplementing the usual deficient diet in endemic areas with milk, yeast, lean meat and liver.

SOURCES OF VITAMINS

In consideration of the use of various foods as sources of vitamin B_1, riboflavin and nicotinic acid, several factors must be kept in mind. These are, in part at least, the relative quantities of vitamins present in the foods in relation to the usual intake of such foods, the method of preparation and the cost. The last is obviously of considerable importance in low-income groups, representing an obstacle which is not easily overcome. As an illustration of the first factor, it may be mentioned that fresh yeast contains significant quantities of nicotinic acid, thiamin and riboflavin, but its use in the treatment of pellagra is practically impossible because of the large amount required daily. For this purpose, however, dried yeast has been used successfully. The method of preparation of foods is of some importance. The mere fact that a certain food gives a high assay value for vitamin B_1, for example, does not necessarily mean that this food provides the vitamin in significant quantities under the usual conditions of preparation and handling. Undoubtedly, large quantities of vitamin B_1 in foods are lost in cooking because of the practice of discarding the water in which foods are cooked. This vitamin is quite soluble in water. Hence, it has been suggested that the water in which vitamin B_1-containing foods are cooked be used in the preparation of broths, soups, etc. Fortunately, thiamine hydrochloride, riboflavin and nicotinic acid are all fairly stable to heat. Losses in cooking and storing vary somewhat with the particular vitamin under consideration and with such conditions as temperature, time and pH. Extended discussion of these matters is contained in the book "The Vitamins." Apparently, many of the ordinary cooking procedures do not result in a serious reduction of vitamin content of food. For example, flour containing vitamin B_1 can be made into bread without great loss of vitamin content. It has been suggested that the stability of thiamine in foods is due to its existence in combined form.[26]

Vitamin B_1 is found in a large number of foods, but very few of these can be considered potent sources of this factor. The vitamin tends to be concentrated in the outer layer of seeds and in the germ portion. Legumes, nuts and whole grains are among the good plant sources; milk, eggs, lean meat and liver are good animal sources.

Clinical studies on pellagrous patients have shown that the following are good sources of nicotinic acid: dried yeast, liver, lean meat, kale, tomatoes, turnip greens, canned salmon, peas and wheat germ.

Riboflavin is widely distributed in the plant and animal kingdoms. It appears to occur less abundantly in seeds than does vitamin B_1. It is found in relatively

high amounts in the green leaves of actively growing plants. Good sources of riboflavin are kale, spinach, turnip greens, wheat germ, liver, milk, eggs, lean meat, carrots (carrot tops are better), tomatoes and apples.

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ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following article in the list of Accepted Dental Remedies.

Dentifrices*

Lactra Dentifrice: Composition: See Sheffield Tooth Paste (A.D.R. Ed. 6, p. 120).

Manufactured by the Sheffield Co., New London, Conn. Distributed by Lactra Tooth Paste Company, New York, N. Y.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information on the rules and work of the Council will be sent on request.

HAROLD L. HANSEN, *Secretary.*

*A.D.R. Ed. 6, p. 111.

THE NATIONAL HEALTH PROGRAM COMMITTEE

THE NATIONAL YOUTH ADMINISTRATION

AN expanded health program is being undertaken by the National Youth Administration in connection with measures for national defense. This program, which is an inclusive one, will provide a limited type of dental care for those under its jurisdiction.

The National Youth Administration is a federal agency established in 1935. It is, at the present time, under the jurisdiction of the Federal Security Administration. It has four main purposes: (1) to provide part-time employment for needy students so that they may continue their education; (2) to provide part-time employment for out-of-school youths, chiefly from relief families, on projects designed not only to afford valuable work experience but also to benefit youth generally; (3) to extend job training, counseling and placement services for NYA youth, and (4) to promote educational and recreational activities for NYA out-of-school project workers.

Recent conferences between the National Health Program Committee and officials of the NYA have brought the assurance that NYA officials, in starting a dental program in the states, will attempt to work with and through the officers of the local and state dental societies.

The phase of the expanded health program of interest to dentists is that dealing with the provision of health facilities for the NYA youth employed on its out-of-school work program. Following is an outline of the proposed program by NYA officials:

The National Youth Administration has initiated a health program to serve the needs of youth employed on its out-of-school work program. This effort to afford young people the experience of practical health education in order to help strengthen the nation's vital defenses by building a strong and healthy population will have three aspects:

1. Physical appraisal, by means of a technically competent health examination, of every youth assigned to an NYA job.

2. Correction of health defects through maximum utilization of community resources, through the use of supplementary medical and dental services provided where possible by the NYA and through developing in youth an interest in improving their health by their own personal efforts.

3. Technical advice and assistance with respect to all NYA efforts having a direct and immediate bearing on the health of youth workers, such as nutrition, sanitation, physical development and recreation.

At the September meeting of the Conference of State and Territorial Health Officers, Aubrey Williams, National Youth Administrator, outlined the purpose and scope of the out-of-school work program. Carl E. Rice, surgeon, U. S. Public Health Service, assigned to the National Youth Administration, presented the general plans for the health program which is under his direction. The Committee on Hospital and Medical Care of this conference endorsed the proposed program.

In addition to extending health services to youth, the National Youth Administration will continue through its work program to improve and extend community health facilities. During the year ending June 30, 1940, the record of accomplishment includes the production of more than 8,000,000 articles of hospital supplies for public institutions, the construction of nine new hospitals and repairs and improvement to sixty-two others, the construction of forty other new buildings concerned with various health activities and repairs and improvements on 131 others. In addition, many youth received work experience in a variety of hospital functions as ward attendants, laboratory assistants and kitchen and laundry workers.

The work program aims to acquaint young workers with modern production methods and prepares them for present employment conditions. Young men and young women

gain practical work experience through employment on projects which produce useful articles, facilities and services for public agencies. Work experience in welding, sheet metal work, radio construction, automobile mechanics, wood-working, sewing, book repair and office work is productive of articles for city and county departments and offices such as police, welfare, health, education and sanitation.

As most of the National Youth Administration's work with unemployed youth has a close relationship to the broad needs of defense, it has been designated as one of the National Defense agencies.

It is estimated that approximately 500,000 out-of-school youth between the ages of 17 and 24 inclusive will be employed on the work program during the fiscal year. About 50 per cent of the youth so employed are young men. The average period of employment is less than one year. All of them come from families in the lower economic brackets.

One important aspect of the NYA work program, the operation of both resident and non-resident projects, influences the character of the health program. About 50,000 youth are employed on resident projects, where they live at the job site under NYA supervision twenty-four hours each day. In these resident projects, the National Youth Administration must assume responsibility for the medical care of a comparatively small group of youth. This is not true for the much larger group of employed youth. The NYA health program is not a medical care program, as responsibility for providing medical care for intercurrent illnesses of the employed youth will remain with the family or community except for the small group mentioned above.

The health examination for all youth will be made largely by designated practicing physicians. This examination follows a standard national form and includes provision for necessary smallpox vaccination, for routine serologic blood tests and urinalysis, and for a routine chest x-ray or a routine tuberculin test followed by chest x-ray examinations for positive reactors. Everything possible is being done to assure the health education value of the examination. The examination is not regarded as a hurdle for youth desiring to enter into NYA employment. The main purposes for giving the examination are to: (a) facilitate work assignment; (b) assist in the guidance of youth in physical development and health education activities, and (c) discover health conditions that need attention.

Naturally, youth with communicable disease, severe heart lesions or mental abnormality must be excluded. It is not intended to exclude any youth from NYA employment because of physical limitations and consequent limitations in work capacity, unless such employment will endanger the life of the individual youth or will endanger the health and safety of other youth.

The rehabilitative effort is aimed at the correction of actual and potential health hazards and those conditions which may not be health hazards but may reduce the employment possibilities and well-being of the youth. Increased employability and work productivity are important at all times, and especially at present. A great part of this effort will be made through influencing the young people to make their own arrangements with physicians and dentists, using a portion of their NYA wage in payment for services. This will require considerable skilful counseling with the youth concerned on the part of NYA personnel. Success will depend also on the degree of consideration and cooperation given this effort by practicing physicians and dentists. In some areas, much of the necessary follow-up work can be secured through existing community agencies, if such is necessary. Such facilities, however, are usually overburdened in taking care of sick people and are not particularly desirable places to send apparently healthy persons, either for examination or for corrective work.

The National Youth Administration will establish its own facilities in some regions in connection with larger projects, utilizing the services of practicing physicians and dentists in the community on a part-time basis. Local economic conditions and the presence or absence of going health facilities will indicate the necessity for NYA supplementation.

The health of NYA employes will also be approached through activities in the field of nutrition, health information, physical development and recreation.

Each state health program will be directed by a physician of outstanding professional

competence, who will serve on the staff of the state administrator on a part-time basis, as health consultant, to give technical supervision and direction to all NYA health efforts. Assisting him and employed on a full-time basis to direct the state-wide health project is the state health supervisor. The supervisor is usually a non-medical person selected from the fields of public health nursing or physical education or from administrative positions in public and private health associations. State-wide health projects in every state operate in collaboration with state public health departments, which are, in most cases, giving material assistance in the supervision and operation of NYA health activities.

One of the main jobs of the health consultant will be to assure the wise expenditure of NYA funds. Another function will be concerned with utilizing existing health facilities to the fullest extent and securing the cooperation of practicing physicians and dentists. He will also be responsible for reviewing and making recommendations concerning medical services rendered in resident centers by physicians and dentists employed on a part-time or full-time basis.

The cooperation of the medical and dental professions will be necessary to enable the plan to succeed. As the various NYA state administrators approach officials and committees of state medical and dental societies, it is hoped that the representatives of the two professions will keep in mind that the NYA health program is primarily a practical health education effort aimed at influencing the future health practices of a group of young, out-of-school, unemployed persons, who will usually remain in NYA employment for only a short period.

The method of attempting to attain this purpose will be through imparting health information and acquainting and introducing the young people to the public and private health facilities available in their own state and community, and finally exposing them to rehabilitative health services obtainable from the private practitioner either on the youth's own initiative or through NYA supplementation as may be indicated.

In a number of cases, dental programs have been established in states without consultation with the state dental society. The National Health Program Committee wishes to emphasize that satisfactory programs can be worked out best through consultation between the NYA and state dental societies within the broad principles laid down by the House of Delegates of the American Dental Association as a basis for operation.[1]

1. Dentistry and Government. Issued by the National Health Program Committee, A.D.A., 1939, p. 14.

SENATE BILL 3607

A BILL "to authorize research by the Public Health Service relating to the cause, diagnosis and treatment of dental diseases" was introduced into the Senate of the United States January 6 by Senator James E. Murray of Montana. This bill (S. 194) is identical with the dental research bill (S. 3607) introduced in the last session of the Congress by Senator Murray. S. 3607 died with the ending of the seventy-sixth Congress after being passed by the Senate and referred to the Committee on Interstate and Foreign Commerce in the House of Representatives.

The new bill, S. 194, has been referred to the Senate Committee on Education and Labor, which issued a favorable report on S. 3607 during the last session.

The National Health Program Committee which sponsored the bill expects that some action will be taken on S. 194 within the next few months.

RESEARCH COMMISSION

TENTATIVE AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 12 FOR DENTURE BASE MATERIAL, ACRYLIC RESIN OR MIXTURES OF ACRYLIC AND OTHER RESINS

By W. T. SWEENEY,* A.B., and G. C. PAFFENBARGER,* D.D.S., Washington, D. C.

FOREWORD

THERE has been considerable chaos in the use and sale of the newer denture base materials. Therefore, the Research Commission of the American Dental Association decided to publish the tentative A.D.A. specification for acrylic resins and mixtures of acrylic and other resins as soon as it was released to the Association by the National Bureau of Standards.

We, therefore, recommend that every user of these denture base materials prior to the appearance of our official list of brands of certified denture base materials write to the respective manufacturer and ask him whether (1) he has tested and (2) unqualifiedly guarantees his material to comply with all items of this tentative specification.

The Research Commission will consider certifications of manufacturers for acrylic resin denture materials from the date of this publication. The Commission hopes to be in a position to publish, at an early date, a list of acrylic resins that have been guaranteed to comply with the following specification and that have been tested by the dental research workers at the National Bureau of Standards, and so found to comply.

Publication authorized by the Executive Board of the Research Commission.

*Research associate of the American Dental Association at the National Bureau of Standards.

TENTATIVE AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 12 FOR DENTURE BASE MATERIAL: ACRYLIC RESIN OR MIXTURES OF ACRYLIC AND OTHER RESINS

DECEMBER 1940

A. General Specification.

This specification is for denture base material composed of polyesters of acrylic acid or substituted acrylic acids or copolymers of these with vinyl esters or styrene.

B. Types.

Three types of materials are specified:

B-1. Type A. Powder and liquid.

B-2. Type B. Plastic cake.

B-3. Type C. Powder.

C. Material.

C-1. Toxicity and Irritation.—No ingredient of the resins shall, after curing, be toxic or irritating to the mouth tissues.

C-2. Impurities.—The material shall be free from dirt, grit or other objectionable foreign materials. Coloring matter shall not be considered a foreign material.

C-3. Form.—The material shall be supplied as:

C-3a. Powder and a liquid.

C-3b. Plastic cake (5 ± 3 mm. thick).

C-3c. Powder.

D. General Requirements.

D-1. Translucency.—A specimen (see F-4) of the cured pink resin 3.2 mm. thick shall be translucent.

D-2. Satisfactory Working Qualities.—The resin when cured according to instructions furnished by the manufacturer shall yield a satisfactory denture. The cured resins shall display the following general properties:

D-2a. A smooth glossy surface.

D-2b. A smooth surface when polished.

D-2c. A smooth unchipped surface when trimmed at room temperature.

D-3. Porosity.—Cross-sectioned specimens (6 mm. in thickness and 25 mm. square) of the cured resin shall not show bubbles or voids by visual inspection.

D-4. Color.—The color of the cured resins shall be as specified by the purchaser, and shall be evenly distributed or uniformly mottled in a cured specimen of the pink resin.

E. Detail Requirements.

E-1. Uncured Material.—The uncured material shall meet the following requirements:

E-1a. Packing Test.—The material shall have sufficient plasticity to mold at 65° C. (see F-2).

E-2. Cured Resin.—The cured resin shall meet the following requirements:

E-2a. Transverse Test.—The deflection of specimens (see F-3) tested in air at 37° C. shall meet the following requirements:

TYPE	Deflection for Loads*		
	4,000 Gm.	6,000 Gm.	
	Maximum Mm.	Minimum Mm.	Maximum Mm.
A, B or C	2.6	3.0	8.0

*Deflection shall be measured from an initial load of 1,500 gm. to the load indicated.

E-2b. Imbibition.—The increase in the weight of the resin shall not be more than 0.6 mg. per square centimeter of surface after immersion in water for twenty-four hours at 25° C. (see F-4).

E-2c. Solubility.—The loss in weight of the specimen used in E-2b shall not be more than 0.1 per cent.

E-2d. The color of the cured resin shall be stable (see F-6).

F. Methods of Inspection and Test.

F-1. Preparation of Specimens.—Specimens of the cured resin shall be made from samples processed in accordance with the directions accompanying the package (G-1).

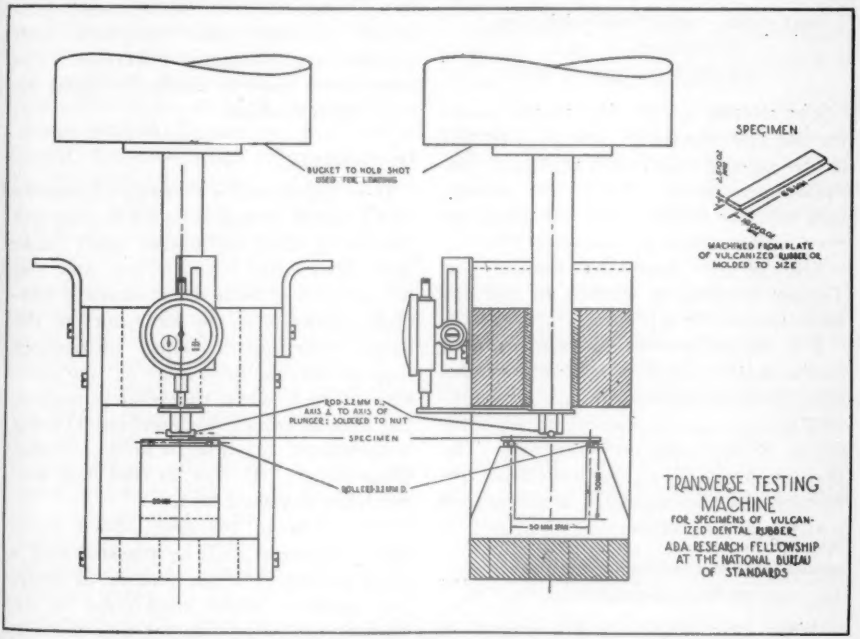
F-2. Packing Test.—The apparatus used in the packing test consists of: A. A flat smooth brass die (5 cm. square and 1 cm. thick) containing holes 0.75 mm. (0.029 inches; using No. 69 drill) and 1.00 mm. (0.040 inches; using No. 60 drill) in diameters. The holes shall be arranged around the center of the block in four concentric circles, the radius of the smallest circle being 5 mm. The holes shall be spaced at 5 mm. intervals on radii 22.5 degrees apart. Those of the inner circle shall be 0.75 mm. in diameter. All others shall be 1.00 mm. in diameter. B. A device for applying a load of 5,000 gm. C. An air chamber, the temperature of which shall be 65±2° C. If the temperature of the flask at the time of packing is given in the manufacturer's directions, the oven shall be adjusted to ±5° C. of the manufacturer's specified temperature (see G-1). All of the equipment shall be brought to 65° C. before the specimen is inserted.

The material shall be handled as directed by the instructions accompanying the package up to the point of packing the case. In Type A material, a suitable plasticity shall be obtained within 10±5 minutes after the start of the mix of the powder and liquid. Then 8±2 gm. of the material shall be placed on the metal die to a depth of approximately 5 mm. The die and specimen shall be quickly transferred to the air chamber and the 5,000 gm. load immediately applied. Ten minutes later, the die

and specimen shall be removed from the oven and stripped from the die.

The material complies with the packing test if it is intruded into at least two of the smaller holes to a depth of more than 0.5 mm.

F-3. Transverse Test.—Transverse tests shall be made on specimens 2.50 mm. thick, 10.00 mm. wide and 65 mm. long. The specimens shall be machined to dimension and finished to a smooth surface. The tolerance on the thickness and the width shall be ±0.03 mm. The prepared specimen shall be stored in water at 37° C. for from two to four days immediately before testing in air at 37° C. The specimen mounted in an appropriate instrument, such as is shown in Figure 1, shall be placed over a 50-mm. span and the load applied in the center of the span. The bearing surfaces shall be 3.2 mm. (0.125 inches) in diameter. The deflection shall be measured at the center of the span by means of an indicator accurate to at least 0.01 mm. An initial load of 1,500 gm. shall be placed on the specimen, the deflection recorded and the additional loads (see E-2b) applied at the rate of 500 gm. per minute. The deflection shall be read one-half minute later. The deflection shall be recorded to the nearest 0.01 mm. The difference between the deflections at the initial load and the total load shall be taken as the deflection of the specimen. The average of the recorded deflections for three specimens shall be reported to the nearest 0.1 mm. When the determined number falls midway between two numbers, the even number shall be recorded.


BUCKET TO HOLD SHOT USED FOR LOADING
SPECIMEN
MACHINED FROM PLATE OF VULCANIZED RUBBER OR MOLDED TO SIZE
SPECIMEN
TRANSVERSE TESTING MACHINE
FOR SPECIMENS OF VULCANIZED DENTAL RUBBER
ADA RESEARCH FELLOWSHIP AT THE NATIONAL BUREAU OF STANDARDS

Instrument for determining transverse properties of denture rubber.

F-4. Water Imbibition.—The water imbibition test shall be made in duplicate on disks 50±1 mm. in diameter and 3.2±.2 mm. thick. All surfaces of the disks shall be smooth, and the top and

bottom shall be flat. The specimens shall be conditioned by drying for twenty-four hours in an oven at 50±3° C., cooled in a desiccator and weighed to 0.1 mg. They are then immersed for twenty-four hours in water at 25±2° C. At the end of this time, they are wiped off with a dry cloth and weighed immediately.

The value for water imbibition shall be calculated as follows for each specimen:

$$\frac{\text{wet weight—conditioned weight (mg.)}}{\text{surface area (sq. cm.)}} = \text{imbibition (mg. per sq. cm.)}$$

The average of the determined values for the two specimens shall be reported to the nearest hundredth milligram per square centimeter. When the average falls midway between two numbers, the even number shall be recorded.

(Reference: American Society for Testing Materials: Method of test for water absorption of plastics. D570—40T.)

F-5. Solubility.—The specimens used in F-4 shall be used in determining solubility by reconditioning them for twenty-four hours in an oven at 50±3° C., cooling in a desiccator and weighing. The percentage soluble matter lost during immersion shall be calculated to the nearest 0.01 per cent as follows:

$$\frac{\text{conditioned weight-reconditioned weight}}{\text{conditioned weight}} \times 100$$

When the reconditioned weight is greater than the conditioned weight, the solubility is reported as none. When the average determined value falls midway between two numbers, the even number shall be recorded.

F-6. Color Stability.—Smooth flat specimens of cured resin shall be exposed to the radiation of a sunlamp BM12 (General Electric) with S-1 bulb. The light source is a combination tungsten-filament mercury-arc enclosed in Corex D glass which filters out the ultraviolet light below 2800 A. The lamp is rated at 450 watts. The specimens are carried on an aluminum disk which is centered under the S-1 bulb and rests on a phonograph turntable, operated at 33 revolutions per minute. The specimens are held approximately 5 mm. above the disk and 5 inches from the center by screws. The plane of the specimen is 6 inches from the bottom of the S-1 bulb. Specimens the size of those used in F-4 are satisfactory. The specimens shall not show any change in color after twenty-four hours' exposure when compared with an unexposed duplicate specimen. The comparison shall be made by visual inspection in daylight.

G. Packaging.

G-1. Direction for Curing.—Adequate and accurate instructions for storing and processing shall accompany each package. These shall be such that they can be carried out with the equipment generally available in the laboratory of the dental practitioner. These instructions shall include the following: (a) temperature of flask when the resin is packed, (b) time to bring to recommended curing temperature, (c) time to hold at curing temperature, (d) how to cool flask and (e) when to release flask.

G-2. Package Marking.—Each package of material shall be marked with a serial number or a combination of letters and numbers which shall refer to the manufacturer's records for that particular lot or batch. The type of resin shall be stated on the outside of each package. For example, if the resin is a mixture of methyl and ethyl methacrylate, it shall be so stated.

G-3. The date of manufacture and recommended method of storage shall be plainly indicated on the outside of the package. The manufacturer may, if he desires, indicate the date of expiration of the guarantee of compliance with this specification.

COMMITTEE ON DENTAL PREPAREDNESS

DENTAL HEALTH CONDITIONS SURROUNDING LARGE CONCENTRATION POINTS

THE Committee on Health and Medical Preparedness appointed by President Roosevelt has requested the cooperation of the Preparedness Committee of the American Dental Association in a study of the dental health conditions surrounding the large concentration points, in order that it may be ascertained whether there are adequate facilities to care for the influx of civilians in the surrounding areas. It is estimated by the United States Public Health Service, on the basis of world war conditions, that for every army individual, an average of one civilian will locate in the surrounding area, increasing tremendously the normal population. Undoubtedly, this will, in many instances, produce a dental health situation which must be met. We should see to it that the problem is carefully studied and solved by the profession itself.

Statisticians of the United States Public Health Service have agreed to furnish figures relative to the present and estimated future populations within these areas and these figures will be available in a comparatively short time. In the meantime, this committee wishes the Military Affairs Committees of the respective states to study the civilian dental personnel within these areas, and offers the suggestion that officials of the societies, secretaries of state boards of dental examiners and dental directors in health departments will be of inestimable value in this connection.

As a guide to the study, the committee suggests that the following information be obtained:

1. The number of civilian dentists (white, colored or Asiatic) within the concentration area.

2. The distribution of the dentists in the areas; in other words, the number and race in each city, town and rural district. In the event a concentration area is located near one or more large cities, it can be assumed that the dental needs will be cared for on the basis of sufficient personnel.

3. In each instance, whether the dentist is a member of the American Dental Association. The colored dentists will be checked later as to their membership in the National Dental Association.

4. The names and locations of hospitals, schools, health departments or other places having dental facilities within the areas and to what extent they may be used for meeting any increased demands.

5. After the study of the civilian population, the dental personnel and other dental facilities have been completed, recommendation on the following points:

(a) Do you feel that dental personnel or other facilities should be increased in the respective areas?

1. If so, would it be feasible to persuade additional civilian dentists to locate in the areas? This seems quite desirable.

2. If so, should the present hospital, school, health department or other clinical facilities be increased? In this connection, it might be mentioned that perhaps quite a number of dependents of draftees located around the camps will be dentally indigent. Some plan of caring for these in private offices or clinics, may have to be worked out in the final determination of the needs.

Tabulated information should be recorded on separate sheets in typewriting (not on the map) and, when returned, it will be carefully placed on the state map and the master map in the possession of the committee. The combined data from all states should prove valuable in studying the entire situation.

The circles on the maps sent out show only those army camps and defense industries of 10,000 population or more, furnished by the War Department, but it is also the intention to study the areas surrounding the navy and marine camps, and other war industries in which the civilian population therein or about is correspondingly abnormal. It is requested, therefore, that as each man is familiar with the conditions in his state, his studies be extended to include the others not specifically indicated by the circles, in order that the situation may be entirely covered and dentistry may attempt to solve any problems which may arise regarding dental care for the defense workers.

It is appreciated that there are undoubtedly conditions in the various states that will require special treatment in connection with the survey and recommendations and the committee desires to be of all possible assistance. Similar studies will be conducted in relation to general medical and health needs by other interested committees.

From the reports and recommendations, the committee will be in a position to inform the government as to what the situation is and how it can best be handled. It is urged, therefore, that the greatest care be taken with the survey and recommendations. It can be readily understood that, under the urgency of the preparedness program, dentistry may be faced with many perplexing problems which it must assist in solving, problems which may have a far-reaching effect on the future. The committee believes that it is vitally important, therefore, that the profession assume the leadership necessary to insure its active professional participation in all of these matters. Up to the present time, it is believed that dentistry has taken its rightful position under the preparedness program, and is performing its obligations, owing principally to the fine spirit of cooperation and earnest work of the profession throughout the states, and unquestionably this new problem, complex as it may be, will likewise be attacked intelligently and be solved.

Committee on Dental Preparedness
C. WILLARD CAMALIER, *Chairman*,
1726 Eye St., N. W.,
Washington, D. C.

G. D. TIMMONS, *Secretary*,
212 East Superior St.,
Chicago, Ill.

MEETING OF NATIONAL PREPAREDNESS COMMITTEE

A CONFERENCE on national preparedness has been called for Monday, February 17, 1941, at 9 a.m., in Private Dining Room No. 1, second floor, Stevens Hotel, Chicago, Ill.

At this time, Wilfred H. Robinson, President of the American Dental Association, General Leigh C. Fairbank, Colonel L. G. Rowntree, Chief, Medical Division, Selective Service System, George C. Dunham, Secretary, President's Health and Medical Preparedness Committee, and officials connected with the Navy Dental Corps and the United States Public Health Service will speak briefly. An opportunity will be given the audience to present questions.

C. WILLARD CAMALIER, *Chairman*,
1726 Eye St., N. W.,
Washington, D. C.

GERALD D. TIMMONS, *Secretary*,
212 East Superior St.,
Chicago, Ill.

QUESTIONNAIRE INFORMATION

HAVE YOU RETURNED YOUR QUESTIONNAIRE?

IF NOT, WILL YOU DO SO AT ONCE?

If you do not have a questionnaire, please write to the American Dental Association, 212 E. Superior St., Chicago, Ill., and one will be forwarded immediately.

You will want your name to appear in the dental directory.

JANUARY 15, 1941, approximately 43,000 questionnaires had been returned to the Preparedness Committee. This represents but approximately 59 per cent of the number which have been mailed to the dentists in the United States. The number of returns is still below the total regular membership of the American Dental Association, which was 47,746 on December 31, 1940. Thus it may be seen that if each member would return his questionnaire at once, the percentage would immediately rise to approximately 66 per cent.

In the main, there seem to be two reasons for failure to return the questionnaires. First, many men are of the opinion that, since they are not eligible for military service because of their age, it is not necessary to return the questionnaire; and, second, there are some who have not returned the blank because they are already serving in the armed forces of the country. In either event, the failure to return the questionnaire defeats one purpose of the survey, the proposed dental directory, which is a very important part of the program.

If you have not received one of the questionnaire forms or if for any reason you should require another form, please write to the American Dental Association, 212 East Superior St., Chicago, Ill., and a copy will be forwarded to you immediately.

Up to December 30, 1940, the returns from all states except Illinois, New York and Ohio had been checked. Following this statement will be found the percentage of returns, by states, as of the above date.

PERCENTAGE OF QUESTIONNAIRE RETURNS BY STATES

State	Number Mailed	Per Cent Returned
Alabama	583	55
Alaska	32	50
Arizona	137	68
Arkansas	380	51
California	5,540	59
Colorado	674	61
Connecticut	1,104	61
Delaware	114	50
District of Columbia	643	48
Florida	705	53
Georgia	736	51
Hawaii	219	67
Idaho	242	53
Indiana	1,915	61
Iowa	1,681	62
Kansas	1,086	53
Kentucky	859	52
Louisiana	720	42
Maine	402	52
Maryland	826	55
Massachusetts	3,000	49
Michigan	2,896	58
Minnesota	2,214	72
Mississippi	469	49
Missouri	2,569	50
Montana	286	68
Nebraska	970	59
Nevada	67	42
New Hampshire	242	55
New Jersey	2,587	58
New Mexico	109	57

North Carolina	915	47	Texas	2,082	52
North Dakota	272	69	Utah	326	57
Oklahoma	760	52	Vermont	156	57
Oregon	876	53	Virginia	901	51
Pennsylvania	6,709	53	Washington	1,291	49
Rhode Island	413	47	West Virginia	630	48
South Carolina	449	37	Wisconsin	2,299	62
South Dakota	309	61	Wyoming	127	60
Tennessee	839	55			

December 30, 1940.

COMMITTEE ON LEGISLATION

THE REFERENDUM ON THE MICHIGAN DENTAL LAW

ON election day, November 5, 1940, the electorate of Michigan were asked to vote upon the question as to whether the recently enacted law for the regulation of the practice of dentistry should be put into effect in the state. This law, passed at the 1939 session of the state legislature, constitutes an almost complete revision of the dental practice act. It imposes restrictions on advertising in addition to those that were incorporated in the old law and grants increased power to the dental board with respect to the regulation of advertising. The dental society had sought amendment of the previous law in both 1935 and 1937, but had been unsuccessful each time. However, the proposals introduced in 1939 were passed by the house with only eleven dissenting votes and by 25 to 0 in the senate, in spite of the opposition of the Michigan Press Association and a small group of so-called advertising dentists.

During the ninety-day period before the act became effective, however, the persons opposing the restrictions upon advertising that it contained had circulated petitions asking that the act be submitted to a referendum and had obtained the required number of signatures of registered voters in the state. The attorney for the dental society made several attempts to have the petitions declared unsatisfactory because they contained fictitious names, etc., but the secretary of state ruled that they were adequate and the courts refused to change his ruling.

The decision that there must be a referendum on the new law meant that the dental society was faced with the task of informing the voters of the purpose and meritorious features of the law so that the voters would be able to vote intelligently on the subject. By this time, the voting day was only about two months off, so the campaign was begun immediately. It was divided into two distinct parts, the first part consisting of a drive to raise money to enable the dental society to conduct the second part of the program, the second, of an educational campaign to inform the electorate regarding the issues upon which they were to vote.

The work which was put into this campaign bespeaks the sincerity with which the dental societies conducted the campaign. Before the date of the vote, the following, among other things, had been accomplished:

Approximately 4,000 speeches had been made before men's and women's clubs, churches and political, civic, social, professional, business and labor groups.

Publicity had been obtained in a great number of newspapers and bulletins throughout the state and by use of billboards, folders, posters and the radio.

Valuable support had been obtained from organized labor because the unions recognized that the act was designed to protect the health of their members. One hundred thousand specially designed folders were distributed to members of the C.I.O. alone.

In Wayne County, where the city of Detroit is located, material had been distributed among the voters in the following quantities; 800,000 yellow cards, 1,500,000 folders, 10,000 auto stickers, 500,000 blue handbuts, 5,000 bumper cards, 10,000 wall cards, six billboard messages, and 500 snipes and 200,000 letters from dentists to patients. These figures give an indication of the size of the campaign and the effort put forth by the dental societies, both state and local.

The results of the referendum justified the amount of time and money expended, the law having been approved by a majority of 218,450 votes of a total of 1,251,650 votes cast. Most of the majority was accumulated in Wayne County since, in the remainder of the state, the vote was approximately even.

The decisive approval of the law by the voters meant that it should have been put into effect last December 13, but, before that time, another barrier was cast in its path by the groups that had opposed its enactment by the legislature and its approval by the voters. December 12, the attorney representing the advertising dentists filed a suit asking for an injunction permanently restraining the law from being put into effect because the referendum had not been legally conducted. Pending its decision, the court issued a temporary restraining order.

The basis for the allegation of illegality of the referendum was given as the fact that, in communities where voting machines were used, the full text of the act was not printed for the information of voters, as required by the state constitution. It was also alleged that, in many of the polling places in Detroit, paper ballots were not available to early voters and that four proposals were illegally submitted on the same ballot. What decision the court will make on these charges cannot be foretold, although it does not appear likely that any of the alleged irregularities could have materially affected the result of the votes.

The dentists of Michigan are to be congratulated on the success of their efforts to ensure the state a law which safeguards the public to the greatest possible extent. The educational campaign which was conducted undoubtedly had other results than the main one of winning the referendum. It undoubtedly made many people aware of the importance of such legislative protection and of the efforts of the dental society in their behalf. This should have valuable results in terms of good will and increased cooperation with the dental profession on future programs.

THE REFERENDUM ON THE AMENDMENTS TO THE ARIZONA DENTAL LAW

THE legislature of Arizona, in its 1939 session, passed certain amendments to the dental practice act dealing with the grounds upon which the state dental board would be permitted to revoke the license of a dentist. In these amendments, the board was given authority to revoke the license of a dentist for: "8. Advertising prices, credit or terms of credit for professional services or materials. . . . 10. Employing or making use of advertising solicitors or free publicity press agents." The effect of the foregoing and other sections of the amend-

ments was to make it clear that advertising by dentists would be greatly restricted as soon as the amendments began to be enforced.

Opposition to the amendments came from certain large newspapers in the state and a few dentists who used the newspapers for advertising purposes. These groups immediately circulated referendum petitions and obtained enough signatures of voters to force a referendum. This meant that the measure would be included on the ballot for the general election November 5, 1940, and the public would decide whether the restrictions should be retained.

In order to bring the real issues before the people, the Arizona State Dental Society conducted a vigorous campaign in behalf of the amendments. The voters were told that the bill did not prohibit all advertising, but merely the "bait" and "lure" types. Representatives of the dental society spoke to civic and other groups and told them of the real purposes of the bill. Circulars, handbills and advertisements were distributed as widely as possible and radio talks were made whenever time could be obtained. Every possible avenue of reaching the voters was used and to the fullest possible extent.

The result of the referendum vote was most disappointing to the dental profession because the majority voted to reject the amendments to the law and permit the present advertising practices to continue. In determining the reasons for this disappointing result, it is not difficult to understand why all the tremendous effort of the dental society members went for nought.

A number of the largest newspapers in the state were directly opposed to the amendments and carried many editorials and large advertisements urging the voters against the amendments. These advertisements took advantage of the patriotic feelings of the voters by alleging that the restrictions would promote "dental dictatorship," and restrict free speech and by other similar claims. They also appealed to the average person's desire to be thrifty by alleging that advertising created volume and volume made it possible to reduce prices.

The largest radio chain in the state is controlled by some of the newspaper publishers who were opposed to the amendments, and a number of broadcasts were made which followed the same general type of attack as the newspapers.

Another factor which was considered important in the defeat of the amendments was the fact that the average voter seems to have a tendency to vote "no" on such propositions when he is not well-informed concerning the merits of the proposal. This reaction, or whatever it might be called, places the greatest burden upon the proponents of the "yes" side of the referendum. The dental society was backing the affirmative side of the referendum, and this may have been another reason for the outcome.

Congress on Dental Education and Licensure

STEVENS HOTEL, CHICAGO, FEBRUARY 15, 1941

Conducted under the auspices of the Council on Dental Education of the American Dental Association

Program

MINOR J. TERRY, Chairman of the Council, Presiding

Morning Session, West Ball Room, 10 a.m.

Professional Education and Licensure

Ray Lyman Wilbur, President of Leland Stanford University and Chairman of the Council on Medical Education and Hospitals of the American Medical Association

The Aims of Dental Education

John T. O'Rourke, Dean of the School of Dentistry of the University of Louisville

The Aims of Licensure in Dentistry

Morton H. Jones, Secretary of the Ohio State Dental Board

Discussion

Luncheon Session, South Ball Room, 1 p.m.

The Harvard Plan of Dental Education

C. Sidney Burwell, Dean of the Medical School of Harvard University

Discussion

Afternoon Session, West Ball Room, 3 p.m.

The Philosophy and Procedure of the Examining Process

Edward S. Jones, Professor of Psychology and Director of Personnel of the University of Buffalo

The Functions of the Council on Dental Education

J. Ben Robinson, Dean of the Baltimore College of Dental Surgery of the University of Maryland

The Functions and Methods of the National Board of Dental Examiners

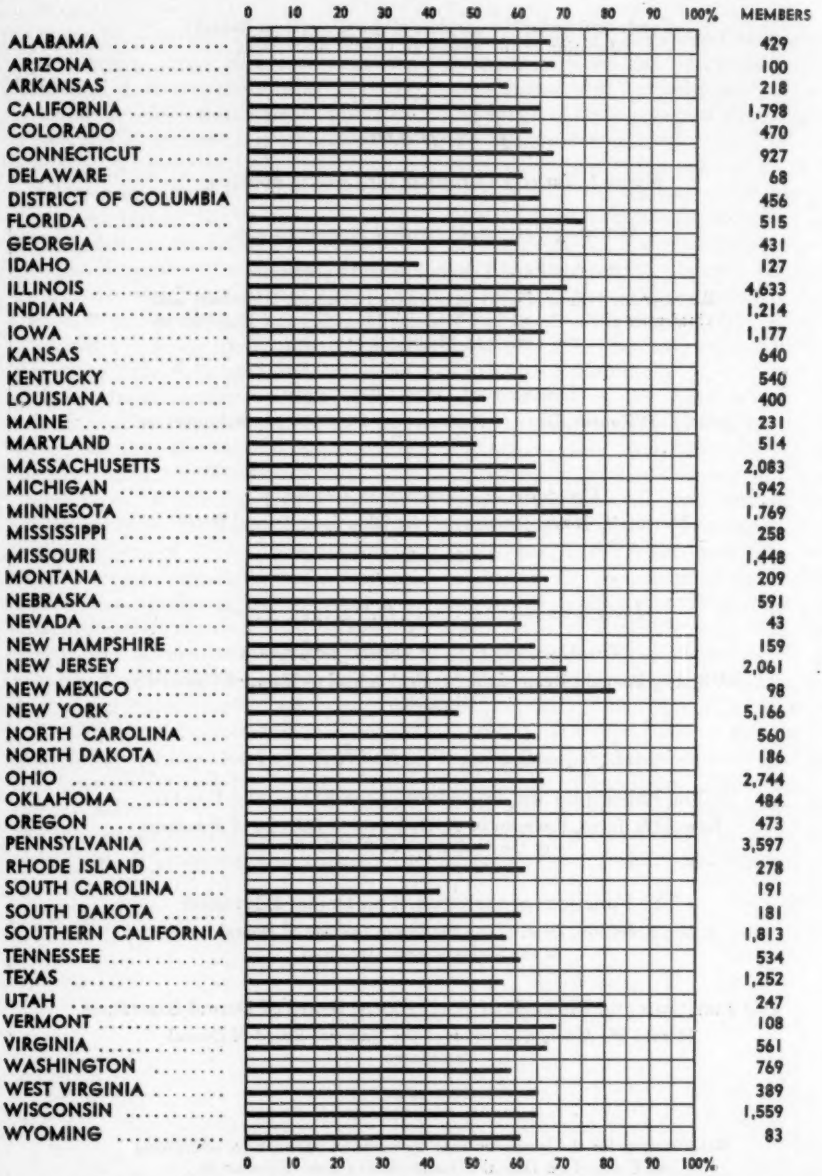
Harold W. Alden, Chairman of the National Board of Dental Examiners

Discussion

Reservations for the luncheon may be made in advance by addressing the Council on Dental Education, 212 East Superior St., Chicago, Ill.

AMERICAN DENTAL ASSOCIATION MEMBERSHIP PERCENTAGE CHART

DECEMBER 31, 1940



Percentage based on dental population figures supplied by State Society Secretaries

AMERICAN DENTAL ASSOCIATION MEMBERSHIP

JUNIOR MEMBERS

1940

Atlanta Southern Dental College	43
Baylor University	63
Chicago College of Dental Surgery	126
College of Physicians and Surgeons	107
Columbia University	155
Creighton University	13
Georgetown University	127
Harvard University	9
Indiana University	45
Kansas City-Western Dental College	70
Loyola University	44
Marquette University	128
Medical College of Virginia	38
New York University	17
North Pacific College of Oregon	114
Northwestern University	21
Ohio State University	79
St. Louis University	20
State University of Iowa	13
Temple University	47
Texas Dental College	52
Tufts College	0
University of California	0
University of Buffalo	18
University of Detroit	45
University of Illinois	11
University of Louisville	2
University of Maryland	66
University of Michigan	38
University of Minnesota	15
University of Nebraska	8
University of Pennsylvania	15
University of Pittsburgh	40
University of Southern California	134
University of Tennessee	4
Washington University	31
Western Reserve University	79
Total Junior Members	1,837

MEMBERSHIP RECAPITULATION

December 31, 1940

Regular Members	47,746
Junior Members	1,837
Affiliate Members	148
Total—All Members	49,731

FEDERAL GOVERNMENT NEEDS DENTAL WORKERS

THE United States Civil Service Commission has announced that applications will be received for the positions in dental work listed below. Vacancies exist in the U. S. Public Health Service, Federal Security Agency, Veterans' Administration and War Department. Applicants must have completed at least 14 units of high-school study. Otherwise, they must pass a written general test. Other competitors will not be required to report for a written test.

The dental laboratory mechanic and assistant dental laboratory mechanic receive $2,000 and $1,440 a year, respectively. The duties are general laboratory dental work. The requirements are educational training or practical experience, or both, in mechanical dentistry.

Dental hygienists receive $1,620 a year. The duties are to assist dental surgeons in their work in hospitals, clinics and relief stations.

Applicants must be registered as dental hygienists and have had certain experience in oral hygiene in public health or school work or in a private dental office.

Applications will be accepted at the commission's Washington office not later than February 6.

Further information and application forms can be obtained from the secretary of the board of the U. S. Civil Service Examiners at any first-class or second-class postoffice or from the U. S. Civil Service Commission, Washington, D. C.

Five State Post Graduate Clinic

WASHINGTON, D. C.
MARCH 9-13

THE District of Columbia Dental Society extends a cordial invitation to all members of the American Dental Association to attend the Annual Five State Post Graduate Clinic at the Mayflower Hotel, Washington, D. C.

The program thus far completed is as follows:

"The Dental Profession and the National Defense Program"

C. WILLARD CAMALIER, Chairman, Committee on Dental Preparedness of the American Dental Association.

C. A. DYKSTRA, Director, National Selective Service System.

A. KNOX, Chief of the Dental Section, Bureau of Medicine and Surgery, U. S. Navy.

LEIGH C. FAIRBANK, Chief, U. S. Army Dental Corps.

GERALD D. TIMMONS, Executive Secretary, American Dental Association.

OLIN KIRKLAND: "Practical Surgical Technic in the Treatment of Advanced Periodontal Lesions."

D. S. THORN: "Treatment of Fractured Incisors."

G. M. DORRANCE and ARTHUR J. DICK: "Cleft Palate Surgery."

L. G. JORDAN: "Refining the Occlusion in Finished Dentures."

LESTER W. BURKET: "Difficulties in the Diagnosis and Treatment of Oral Fusospirochetosis (Vincent's Infection)."

FRED W. HINDS: "Esthetics and Retention in Restorative Dentistry."

WALTER J. PRYOR: "Present-Day Advances in the Art of Producing Lifelike Dentures."

MARK D. ELLIOTT: "Dentistry for Children."

ERNEST R. GRANGER: "Removable and Porcelain Bridgework."

PAUL V. CHEVALIER: "Mouth Rehabilitation."

THOMAS A. MCFALL: "A Study of the Use of Acrylic Resin for the Construction of Inlays, Crowns and Fixed Bridges."

L. E. KOCHER: "Dental Economics."

REED H. GERARD: "Operative Dentistry."

For entertainment, there will be stag night, a buffet supper, a dinner dance, a style show, a state officers' luncheon, hygienists' luncheon, hobby show, commercial exhibits and sightseeing trips.

WALTER A. RATH, *Chairman,*
Publicity Committee,
1835 Eye St., N. W.,
Washington, D. C.

NEWS ITEMS

NATIONAL DENTAL HYGIENE ASSOCIATION, INC. A MEMORIAL TO WILLIAM HENRY HALL

JAMES J. MORGAN, chairman of the Board of Directors of the Martha M. Hall Foundation, today announced the organization and incorporation of the National Dental Hygiene Association by the Martha M. Hall Foundation of New York, to advance, through education, research and community aid, better dental health for a larger percentage of the people of the United States.

The National Dental Hygiene Association, a memorial to William Henry Hall, has opened its headquarters in Washington, D. C., and from here its activities will henceforth be directed.

Randolph G. Bishop, for the past four years assistant director and campaign manager of the Washington, D. C., Community Chest, and for many years associated with philanthropic, health and educational organizations and institutions as a member of the staff of Tamblyn and Brown of New York, has been appointed executive secretary of the association.

In the development of its program, the National Dental Hygiene Association expects to coordinate its efforts with those of the American Dental Association and its component societies and with the dental programs being conducted by state health departments.

A basic feature of the program will be the encouragement of lay support and participation in the field of dental health through cooperation with community health and welfare groups in the planning of coordinated educational and service programs.

The association will publish approved educational material for lay consumption, further dental research work and promote a broader understanding of the basic relationship of dental care to the health needs of the community and country.

NATIONAL SOCIAL HYGIENE DAY

WALTER CLARKE, executive director, the American Social Hygiene Association, announces that National Social Hygiene Day, one of America's leading public health events, will be observed for the fifth time on February 5, 1941.

The fifth Social Hygiene Day will be the spearhead of a concerted drive to safeguard men in military and naval training camps and in essential industries from the ravages of venereal disease. The effort this year is aimed at reducing commercialized prostitution to a minimum and keeping syphilis and gonorrhea infection rates as low as possible in army, navy and defense industrial personnel.

Plans for the annual event include more than 5,000 community meetings in all parts of the country and four regional conferences to be held in Philadelphia, St. Louis, New Orleans and Los Angeles.

Speaking at a recent meeting of social hygiene executives and medical officers in Washington, Ray Lyman Wilbur, president of the American Social Hygiene Association and former Secretary of the Interior, called upon the public and civilian officials to cooperate in making their communities safe from infection.

OBITUARY

ARVAH ST. CLAIR HOPKINS, D.D.S. (1894-1940)

ARVAH ST. CLAIR HOPKINS was born in Fernandina, Florida, November 22, 1894. At the age of 9, he moved with his family to Gulfport, Miss., where he was educated in the public schools. In 1916, he was graduated from Vanderbilt University School of Dentistry, and he immediately entered upon the practice of his profession in his home city. Early in his professional career, he became interested in periodontia and he soon became known in his chosen specialty as one of the most skilful practitioners in the South.

From the day of graduation, Dr. Hopkins identified himself with organized dentistry and took an active part in its advancement. He was past president of the Mississippi State Dental Society and a member of the American Dental Association and the American Academy of Periodontology. He was a frequent contributor to the literature of his profession, especially in the field of periodontology.

Dr. Hopkins was one of Gulfport's most public spirited citizens, having taken an active part in the organization of many of its civic activities. He was a charter member of the Gulfport Yacht Club and for many years served as commodore. Largely through his leadership, Gulfport became one of the centers of sailing activities in the South. In 1937, under the capable administration of Dr. Hopkins, the Yacht Club acted as host to the Thomas Lipton races. Dr. Hopkins was himself an enthusiastic yachtsman and had sailed against many of the outstanding yachtsmen of this country.

His work with the chamber of commerce, of which he had been a director for ten years, had on many occasions received the commendation of his fellow citizens. In 1931, he was elected president of the Kiwanis Club, and he was instrumental in giving to it one of its most successful administrations. In addition to numerous other affiliations designed to further intelligent citizenship, good fellowship and community spirit, Dr. Hopkins served as steward in the First Methodist Episcopal Church in Gulfport, and taught in the Sunday School.

Civic minded beyond most of his colleagues, unselfish always, Dr. Hopkins responded to every call that had for its objective the advancement of his profession and the civic welfare of the community in which he lived.

In his death, the dental profession has lost a valued member and the City of Gulfport one of its most valuable citizens.

Dr. Hopkins is survived by his wife, Florence Montgomery Hopkins, three children, Arvah, Alma and Elizabeth, his father and a brother.

He died after an operation, August 17, 1940.

DEATHS

ANDERSON, A. A., Harlowton, Mont.; State University of Iowa, College of Dentistry, 1911; died May 14.

APPLE, WILLIAM L., West Carrollton, Ohio; Cincinnati College of Dental Surgery, 1907; died December 1; aged 62.

BARKER, WILLIAM H. H., Pella, Iowa; Northwestern University Dental School; died November 8; aged 100.

BELDING, GEORGE H., Milwaukee, Wis.; State University of Iowa College of Dentistry, 1891; died September 15.

COYLE, THOMAS FINLEY, Orange, Texas; died November 30; aged 64.

DORMAN, LEE V., Chicago, Ill.; Texas Dental College, 1934; died recently; aged 37.

FORNEY, JOHN W., Osceola, Iowa; Western Dental College, 1904; died September 22; aged 60.

GOETZ, J. LOUIS, Wapakoneta, Ohio; Cincinnati College of Dental Surgery, 1900; died December 5.

GOLDSMITH, JULIUS, Philadelphia, Pa.; University of Pennsylvania School of Dentistry, 1910; died December 8; aged 56.

JOBLOVE, GEORGE, Brooklyn, N. Y.; New York College of Dentistry, 1917; died October 25.

MCNEILL, EDWARD W., Brooklyn, N. Y.; New York College of Dentistry, 1891; died October 25.

MATTESON, DAVID M., Adrian, Mich.; University of Michigan School of Dentistry, 1900; died September 23; aged 65.

MINCH, FRANK P., Bloomington, Ill.; Chicago College of Dental Surgery, 1914; died October 28; aged 48.

MORRISSEY, CHARLES F., Hartford, Conn.; Baltimore College of Dental Surgery, 1905; died recently.

PECK, ALONZO L., Burbank, Calif.; died October 25; aged 90.

PICARD, J. MILTON, New York, N. Y.; New York University College of Dentistry, 1898; died November 5.

REAGIN, THOMAS B., Du Quoin, Ill.; Vanderbilt University, 1894; died October 11; aged 74.

ROBERTSON, A. A., Marlow, Okla.; died September 11; aged 78.

ROLLINS, GUY H., Fredericksburg, Iowa; Northwestern University Dental School, 1896; died October 28; aged 73.

SHERRILL, KENNETH L., Chicago, Ill.; Chicago College of Dental Surgery, 1926; died October 30; aged 38.

SHORT, J. R., Huntington, W. Va.; Baltimore College of Dental Surgery; died October 20; aged 48.

SPRING, WILLIAM A., New York, N. Y.; Temple University School of Dentistry, 1889; died November 22.

STOUGHTON, HERBERT A., Philadelphia, Pa.; University of Pennsylvania College of Dentistry, 1899; died October 8; aged 62.

TAINTER, BERTRAM G., Milwaukee, Wis.; Milwaukee Medical College, 1904; died October 19; aged 59.

VARN, MILES HERBERT, SR., Atlanta, Ga.; Southern Dental College, 1913; died September 8; aged 49.

WILLIAMS, ARTHUR D., Toledo, Ohio; Philadelphia Dental College, 1897; died December 8; aged 71.

WILLMAN, CLARENCE W., Elgin, Ill.; Chicago College of Dental Surgery, 1914; died November 8; aged 48.

CURRENT LITERATURE

Sulphanilamide in Prophylaxis of Dry Socket

By Barney B. Barab

The author describes the use of sulfanilamide as a prophylactic after the extraction of all mandibular molar and bicuspid teeth. Records would indicate that 95 per cent of all dry sockets occurred in these areas. A tablet of 1½ grains is placed in the socket after the initial bleeding has ceased. Results seem to indicate beyond mere coincidence that postoperative swelling and pain were considerably diminished by this form of treatment.—*D. J. Australia,* 12:617, October 1940.

A. Pearson.

Short Account of Radiographic Technique as Applied to the Study of Phonetics

By H. W. Gillespie

In a simplified method for taking roentgenograms of the tongue in its various positions during speech, the tongue is coated with a radiopaque liquid and two roentgenograms are taken, one of the bony structure and one of the soft tissues. These two are then contact-printed on to the same print.—*J. Laryng. & Otol.,* 55:387, August 1940.

W. F. Koss.

Pellagra in Infancy and Childhood

By T. D. Spies, Alfred A. Walker and Arthur W. Woods

In this study, the habitual environment and dietary of more than 800 pellagrins in the Nutrition Clinic of the Hillman Hospital, in Birmingham, Ala., were investigated. The study was extended to other members of the family and included the dogs that were fed table scraps. Many of the subjects studied showed pellagra.

An investigation of maternal diet during pregnancy and lactation revealed its inadequacy, which resulted in breast milk of poor quality and insufficient amount. Infants weaned early preferred carbohydrates, and analyses of the dietaries of such children showed that, in most cases, their diets were unbalanced and failed to supply adequate amounts of the foods essential for proper nutrition. Symptoms of the disease are infrequent in infancy, but appear early in childhood, consisting of underweight, underdevelopment, undernourishment and general ill-health. Dullness and listlessness are common symptoms and the children complained of soreness of the lips and tongue accompanied by burning pains in the stomach. Constipation is common, with occasional periods of diarrhea. The administration of nicotinic acid or yeast led to dramatic improvement in the cases studied.—*J.A.M.A.,* 113:1481, October 14, 1939.

Virgil D. Cheyne.

Quantitative Studies in the Development of the Rat Molar. II. Alveolar Bone, Cementum, and Eruption (From Birth to 500 Days)

By M. M. Hoffman and Isaac Schour

This study attempts to analyze the growth pattern of alveolar bone and cementum (primary and secondary) and the eruption pattern of the rat molar. Vital staining with alizarin red S to demarcate fixed dentin or bony points and roentgenographic and microscopic technics were used. Sixty-three white rats, from birth to 500 days, were killed at stated intervals for study. The colony was supplemented with skulls from the original Wistar stock. Most of the measurements were made on the maxillary and mandibular first molars.

The gross and roentgenographic findings demonstrated that the height of the clinical crown remains relatively constant throughout life (as measured from the crest of the gingivae to the tips of the mesiobuccal cusps). The extra-alveolar height of the molar remains constant in height except on the lingual aspect, where there is a slight resorption. The occlusal movement of the cemento-enamel junction is more rapid than that of the alveolar crest, and this accounts

for the constancy of the clinical crown height. The total length of the tooth increases with age, in spite of reduction of the anatomic crown by attrition. This is due primarily to dentin deposition until the twelfth week and, after that, to cementum apposition at the apex.

The histologic findings demonstrate that primary cementum apposition is continuous, but slows down with age. Its increments are parallel with the dentino-enamel junction and the long axis of the root. Apposition of secondary cementum begins at 35 days of age, and at 80 days it is entirely responsible for root elongation. It also slows down with age.

The apposition of alveolar bone is subservient to the physiologic migration of the tooth. The walls show appositional and resorptional adjustments to the movement of the tooth. The bone continues in an occlusal direction at the crests and the fundi. The crest shows the most rapid rate of apposition.

The width of the periodontal membrane at the apical region and at the interradicular crest remains relatively constant throughout the first 500 days. The measurements at other levels along the walls show the width to be an inverse function of the age.

The rate of eruption was measured by (1) the rate of change of the position of the cemento-enamel junction in relation to the dated alizarin red S effects in the alveolar crest and (2) the sum of the rates of apposition of fundic bone plus the rate of root elongation. Eruption begins before the crown is completed and was greatest prior to the establishment of functional occlusion. It decreased, but did not stop, with age. With occlusal eruption, the tooth migrates mesially and buccally.

In summary, it may be concluded that tooth development, which in its broadest sense consists of growth, calcification, eruption and attrition, and the development of the supporting structures, continues to at least 1,000 days of age and, in all probability, throughout the life of the rat. Normal alveolar bone growth is secondary to tooth growth, tooth eruption and the forces exerted on the tooth. Root growth is continuous, compensating for the continuous process of attrition so that the clinical crown remains constant in size. The apposition of secondary dentin is responsible for tooth eruption and also causes the pulp to recede.—*Am. J. Orthodontics,* 26:854, September 1940.

VIRGIL D. CHEYNE.

Life Expectancy and Mortality from Skin and Lip Cancer

By SIGISMUND PELLER

THE author has studied 715 cases of lip and cheek epithelioma in order to estimate its life shortening propensity. The average age of 695 of the patients with given age data on onset of the disease was 58.6 years. Three hundred seven of the 715 were lip cancers. The patients were at the onset as well as at the time of death younger than in the skin cancer cases (two and a half and one and a half years, respectively). In general, at the onset of the disease, persons having an epithelioma of the skin or the lip are about as old as the average of all other cancer patients. At the time of death, however, they are older.

The influence upon life expectation and mortality depends on the age at onset. Skin and lip cancer patients below 60 years have an increased mortality and a shortened life expectancy, as compared with the average population at the same age. Cases with the onset of the epithelioma at ages above 70 have a lower mortality and a higher life expectancy. At the beginning of the "cancer age" (40 years), the total group of future surface cancer patients most probably have a future life surplus as compared with the total population of the same age. This indicates that the primary internal cancers do not develop frequently in those who have or have had surface cancers to diminish the life expectancy in this group or to offset the value of therapy in the surface malignancies.—*Am. J. M. Sc.,* 199:449, April 1940.

VIRGIL D. CHEYNE.

Effects of Yellow Phosphorus and Arsenic Trioxide on Growing Bones and Growing Teeth

By CARROLL O. ADAMS and BERNARD G. SARNAT

THIRTY-FOUR rabbits, 27 to 87 days of age, and 32 rats, 28 to 56 days of age, were used to test the effects of ingestion of yellow phosphorus and arsenic trioxide. One-half

of the rabbits were given 0.6 mg. of yellow phosphorus daily for periods varying from thirteen to 117 days. Two rabbits were given 0.6 mg. of arsenic trioxide for twenty-eight days. The dose was gradually increased to 6.0 mg. Yellow phosphorus was given to fourteen rats for periods varying from twenty-two to fifty-seven days in concentrations of 0.01 per cent. In six, the phosphorus was increased fourfold during the last week of the experiment. Arsenic trioxide varying in amount from 0.002 to 0.05 per cent was administered to five rats.

In each type of animal, the general toxic effect of the drugs was manifest by a reduction in weight gain and in growth of the tibial diaphysis. In the case of animals receiving phosphorus, the metaphysis of the growing bone showed a zone of increased density, the "phosphorus band," which was due to diminished resorption of the cartilage matrix and bone in the metaphysis, where extremely active bone resorption is a prominent feature of the process of normal endochondral bone growth. No similar effect of arsenic trioxide on bone was found in either the rat or the rabbit.

In growing incisor and molar teeth of animals given yellow phosphorus and arsenic trioxide, zones of abnormally calcified dentin were found which corresponded to the periods of drug ingestion. Disturbances were proportional to the amount of drug given. Roentgenographically, these zones were not increased in density.—*Arch. Path.*, 30:1192, December 1940.

VIRGIL D. CHEYNE.

Saliva and Enamel Decalcification. IV. Factors Involved in the Prevention of Caries

By J. T. GORE

THE author presents experimental evidence of the acid neutralizing power of the saliva on high and low carbohydrate diets as well as the protective action of the calcium and phosphate ions in the saliva.

The composition of the mineral phrase (the ratio of tricalcium phosphate to per cent calcium carbonate) of enamel is the determining factor in the amount and type of decalcification which takes place if there is an adequate concentration of hydrogen calcium and phosphate ions in the saliva.

Microscopically, there are two types of decalcification: 1. Decalcification of the intercolumnar substance of enamel without loss of surface continuity, produced in an adequate concentration of hydrogen calcium and phosphate ions in the saliva. The calcium carbonate is dissolved out of the intercolumnar substance without dissolution of the tricalcium phosphate. 2. Decalcification of the enamel prisms and intercolumnar substance with loss of surface continuity. The calcium carbonate and tricalcium phosphate are dissolved in an adequate concentration of hydrogen and a deficiency of calcium and phosphate ions. These two types of decalcification were produced experimentally by placing extracted teeth with normal enamel in a saliva-dextrose-tricalcium phosphate solution in an incubator at 37° C. to produce fermentation.

The explanation of enamel decalcification is in terms of ionic equilibrium. Enamel is primarily composed of calcium and phosphates. Tricalcium phosphate in solution is present in saliva; hence, the calcium and phosphate ions are present in a state of equilibrium and remain at a constant. If there is a disturbance of the ionic composition of the saliva, a dissolution of the calcium carbonate, or of the calcium carbonate and tricalcium phosphate of the enamel occurs, to restore the ionic equilibrium.—*J. D. Res.*, 19:455, October 1940.

J. WILLIAM LYTLE.

Foci of Infection in Psychiatric Patients

By CHARLES H. BROWN

THE purpose of this study was to determine the incidence of foci of infection in group of patients who were otherwise apparently physically well. The patients were selected from psychotic patients who were hospitalized because of mental rather than physical weakness. Two hundred thirty-nine patients were studied and the incidence of foci of infection for the entire group was 62.8 per cent. The majority had a minimum of three foci examinations (160), while 202 out of 239 had at least two foci checks. With the greater number of checks, the known incidence rose. None of the patients had arthritis and only two had rheumatic heart disease, both diseases widely thought to be caused by foci of infection. From this, it is evident that other conditions than just a focus of infection must be present in the arthritic

patient. The author suggests that such a patient is allergic to the bacteria present or that there is some constitutional hereditary predisposition to arthritis.

The most common sites of foci of infection in the study were the nose and throat (44 per cent). The foci were: dental, 37 per cent; gynecologic, 22 per cent; urologic, 17 per cent, and cardiorespiratory, 1.6 per cent. The most common nose and throat infections were chronic tonsillitis and sinusitis. The most common dental infections were apical or alveolar abscesses in pulpless or carious teeth, or in root fragments (30 per cent). The next most common source in the mouth was pyorrhea. Prostatitis was high in patients having general paralysis. The most common focus of infection in the female genitalia was chronic cervicitis. Foci in the chest were rare. Such conditions as syphilitic and rheumatic heart disease, hypertension and arteriosclerosis were not considered.—*Am. J. M. Sc.*, 199:539, April 1940.

VIRGIL D. CHEYNE.

Preanesthetic Medication with Special Consideration of the Problems in Maxillofacial Surgery

By EDWARD E. LYMAN

PREMEDICATION, a most important adjunct of efficient anesthesia, should be a routine procedure, the hypnotic selected being determined by the physical condition of the patient, the nature of the proposed operation and the anesthesia of choice.

Premedication problems in maxillofacial surgery are not the same as those of general surgery. In the latter, muscular relaxation is imperative and prolongation of narcotization after operation is important. In the former, as deep narcotization as possible with retention of the cough reflex is desirable. The psychic effect of premedication is actually a safeguard against loss of energy or the expenditure of reserves which the patient can ill afford.

Properties of an ideal hypnotic are summarized, after which the author discusses the more popular drugs in use today; paraldehyde, tribromethylalcohol and the barbiturates.

Morphine is shown to be contraindicated in combination with cyclopropane. The barbiturates are contraindicated in impaired liver function. Fast-acting barbiturates, either seconal or pentobarbital sodium, are to be preferred as a basal narcotic for maxillofacial surgery.—*Mil. Surgeon*, 88:57, January 1941.

JAMES STRIEGEL.

Pemphigus Localized in the Mouth

By E. I. MATIS

PEMPHIGUS is usually localized on the skin of the body, where there are characteristic signs. It is rare for it to be localized in the oral cavity, and, for that reason, it presents many peculiarities in its development and much difficulty in diagnosis. The characteristic skin lesions (bullae) may appear toward the end of the illness. Bullae in the mouth, pharynx and larynx may not be detected because they burst in a very short time after their appearance. Any spread of these lesions from the anterior parts of the mouth to the pharynx and larynx does much to facilitate diagnosis because this spread is not common in many oral diseases.—*Ann. Otol., Rhin. & Laryng.*, 49:991-95, December 1940.

JAMES T. GINN.

Physiology of Mastication

By M. KLOTSKY

THE masticatory apparatus includes those tissues involved in chewing, crushing and comminution of food preparatory to chewing. Specifically, we are concerned with the jaw, the muscles of mastication and the temporomandibular joint. The motions of chewing are brought about by the combined action of certain pairs of muscles, and by virtue of the structure of the temporomandibular joint. The movements may be an anteroposterior gliding action or a lateral motion, or a combination of these.—*D. J. Australia*, 12:670, November 1940.

A. PEARSON.

A Clinical and Pathologic Study of Oral Diseases

By FRANCIS P. MCCARTHY

THIS study is based upon 2,300 consecutive cases. Local irritation due to faulty occlusion and artificial dentures is definitely the most important factor in focal oral lesions. Leukoplakia buccalis represents the most frequent and the most important lesion of the oral cavity, and Vincent's infection

may be classified as an uncommon oral condition. The use of dilantin sodium, a new drug in the treatment of epilepsy, is the cause of a severe form of hyperplastic gingivitis. Gingival lesions are the least understood of all oral lesions, but it should be remembered that in the examination of the oral cavity, local factors should be ruled out before consideration of the rarer causes of oral diseases.—*J.A.M.A.*, 116:16, January 4, 1941.

JAMES T. GINN.

Practical Points in the Diagnosis and Treatment of Fractures of the Jaw

By J. A. DOHERTY

FRACTURE of the jaws may have serious complications. For this reason, a complete clinical and roentgenographic study should be made of such cases. The mandible is more frequently fractured than the maxilla. The displacement of the parts is accentuated by the muscle pull. The treatment has for its aim the overcoming of muscular pull and maintenance of the parts in proper position. When teeth are present, the normal occlusion should be reestablished. The modern procedures are all modifications of the basic ideas of Gilmer. Postoperative care consists of maintaining good oral hygiene and an adequate diet and keeping up the general health of the patient.—*Surg. Gynec. & Obst.*, 72:96, January 1941.

W. F. KOSS.

Nicotinic Acid for Vincent's Disease

By J. H. GUION

THE author reports the good results obtained from the use of 250 mg. of nicotinic acid daily for ten days on patients with Vincent's disease. However, he suggests that the results of research work to date do not justify the use of nicotinic acid alone as a treatment for Vincent's infection.—*South. Med. & Surg.*, 102:735, December 1940.

E. C. WOODS.

A Dental Service in the Military Establishment

By LEIGH C. FAIRBANK

IN view of the present emergency that threatens us, this is a timely discussion, including a clear prospectus of the interrelation and interdependence of the various branches of the Medical Department. For the past forty years, and especially since the start of the World War, the Dental Corps has demonstrated its ever-increasing importance as a unit of the Medical Department of the Army. Perhaps no field in all our medical service draws medical and dental personnel closer together in their professional activities than does the maxillofacial group provided to care for gunshot wounds of the face and jaws. The medical service in the Army has a long and illustrious history and there is stimulation in the thought of effective teamwork as it exists therein.—*Mil. Surgeon*, 88:29, January 1941.

JAMES STRIEGEL.

Tannreduksjonen i Hvirveldyrrekken og Sjöpattedyrenes Tenner (Tooth Reduction in the Vertebrates and Marine Mammalia)

By T. KRAM

THE author has studied the gradual reduction in the number of teeth in the row of vertebrates, which is followed by complications in the forming of the single tooth. It is shown, on the other hand, that the teeth of the marine mammalia consist of numerous simply formed teeth which must have developed from teeth that were fewer but more complex in form. How this process of development could have taken place is discussed, with due consideration of other work in the field.—*Norske Tannlaegefor. Tid.*, 50:184, October 1940.

R. F. SOGNNAES.

Massive Destruction of the Face

By CHARLES C. DENNIE, THOMAS R. HAMILTON and HENRY F. QUINN

THE authors give a complete report on a case of massive destruction of the face. In the smears, coarse spirals were found, probably belonging to the Vincent group, and small spirals, which, they believe, belong to the microdentium family. *Spirochaeta microdentium* is a normal inhabitant of the mouth and believed nonpathogenic, yet they have found cases of partial jaw destruction in which it was the only organism found. The authors think that these organisms are capable of becoming pathogenic in persons who are in an anergic state.—*Arch. Derm. & Syph.*, 42:1040, December 1940.

C. C. WOODS.

INCIDENTS OF PRACTICE

Resorption of Roots of Deciduous Second Molar

By E. H. Season, D.D.S., Dallas, Texas.

A girl, aged 9, had a lower left bicuspid congenitally missing, but the second deciduous molar was in normal position. A roentgenogram of this region made in a routine

examination and shown here seems to offer additional evidence in the much debated question concerning resorption of the deciduous teeth on eruption of the permanent teeth. In this case, there was definite resorption of the roots of the deciduous second molar with no second bicuspid present in the mandible.

Maple and Welborn Streets.

A Freak Bridge

By Harry B. Johnston, D.D.S., Atlanta, Ga.

The freak dental bridge shown in the illustration is a wing bridge consisting of two

bicuspid and two molar teeth, supported entirely by a shell crown on the cuspid. The patient stated that it had been worn for twelve years, though it was "not much good for masticating." The bone and soft tissue under the bridge were in remarkably good condition. It was necessary to use two intraoral films in order to include the entire bridge in the roentgenogram.

831 Candler Building.

Vital Fractured Tooth

By Martin T. Siegel, D.D.S., Poughkeepsie, N. Y.

A woman, aged 22, complained of a tender, dull sensation in the maxillary left first incisor. Upon x-ray examination, pulp testing, etc., the tooth appeared to be non-vital. The interesting feature is that, in November 1939, the patient was in an automobile accident in which both the right and the left first

incisors were injured. The right first incisor, as seen in the roentgenogram, suffered a complete fracture of the root, but was definitely vital to all tests. The left first incisor was non-vital and was painful. It seems that the fractured tooth would also have become non-vital, but this was not the case.

39 Market Street.

Another Use of Hydrocolloid Impression Material for Inlay Construction

By R. J. DeWolf, D.D.S., Harvard, Ill.

The more efficient method for the construction of the gold or cast inlay by the

indirect method, in the modern dental practice here presented saves time for the operator and the patient, whose time may also be valuable. The method is applicable for the restoration of Class I and Class II cavities.

The steps are as follows:

1. Prepare the cavities by the method now employed.
2. Take a hydrocolloid impression of the upper and lower teeth.
3. Pour and articulate models (using No. 2 investment).
4. Wax into the investment and contour the inlay patterns.
5. Remove the models with waxed inlays embedded from the articulator.
6. Sprue to the individual waxed inlays, having wax reservoirs on the sprue, and invest with investment No. 3.
7. Eliminate the wax by placing the case in a receptacle employed for that purpose, such as an electric oven.
8. Carry to a high heat and cast.
9. Polish, place the castings in the mouth, cement the castings to place, adjust the occlusion and dismiss the patient.
10. Have patient return for final observation.

Premature Eruption of Deciduous Teeth

By IRA L. KOHLER, D.D.S., Houston, Texas.

A 15-day-old boy, referred by Judson Taylor, had an acute sublingual cellulitis resulting from eruption of two lower deciduous central incisor teeth. He was born with these two teeth *in situ* and they became abscessed from traumatic injury resulting from nursing on a rubber nipple. The teeth were removed under a topical anesthesia and the patient improved rapidly. This is probably the earliest removal of two abscessed teeth on record.

626 Medical Arts Building.

Use of a Broken-Off Root for Anchorage

By H. H. GOULD, D.D.S., New York, N. Y.

AN upper right lateral incisor carrying a fixed bridge to the second bicuspid, and replacing a cuspid and first bicuspid, was found to be badly broken down. Roentgen-ray examination revealed an area at the apex, and it was also noted that the entire cuspid root had been left in the socket after attempted extraction years previously. Patient had no knowledge of the presence of the root, as it was completely covered. (Fig. 1.)

Figure 1. (Gould)

Figure 2. (Gould)

Figure 3. (Gould)

It was found advisable to remove the bridge, resect the tissue, isolate the cuspid stump and perform a root-canal operation. Calcification prevented complete filling of the canal. The bridge was repaired, with a post in the cuspid root as anchorage, and replacing the lateral incisor immediately after extraction. (Figs. 2 and 3.)

Here was one instance in which it was fortunate for the patient that a root had been left in after an extraction, as it probably would have been a difficult restoration without the aid of the root.

285 Madison Avenue.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ASSOCIATION OF ORTHODONTISTS, New York, N. Y., May 5-8.

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Houston, Texas, October 27-31.

AMERICAN DENTAL ASSOCIATION, Houston, Texas, October 27-31.

AMERICAN PUBLIC HEALTH ASSOCIATION, Atlantic City, N. J., October 14-17.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY, INC., New York, N. Y., March 24.

CHICAGO DENTAL SOCIETY, MIDWINTER MEETING, February 17-20.

CLEVELAND DENTAL SOCIETY, Cleveland, Ohio, May 5-7.

DALLAS MIDWINTER DENTAL CLINIC, Dallas, Texas, April 21-23.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month from October to June at the United States Public Health Service Auditorium, Washington.

FIVE STATE POST GRADUATE CLINIC, Washington, D. C., March 9-13.

ILLINOIS STATE ORAL HYGIENISTS' ASSOCIATION, Chicago, Ill., February 17-20.

INTERNATIONAL COLLEGE OF DENTISTS, U. S. A. SECTION, Chicago, Ill., February 16.

KANSAS CITY-WESTERN DENTAL COLLEGE DIAMOND JUBILEE, Kansas City, Mo., March 24-25.

PACIFIC COAST SOCIETY OF ORTHODONTISTS, San Francisco, Calif., February 20-22.

PHILADELPHIA DENTAL COLLEGE ALUMNI SOCIETY, Philadelphia, Pa., May 21-22.

GREATER PHILADELPHIA ANNUAL MEETING, February 4-7.

PIERRE FAUCHARD ACADEMY, Chicago, Ill., February 17.

ST. LOUIS UNIVERSITY DENTAL ALUMNI ASSOCIATION, St. Louis, Mo., March 5-6.

SIGMA EPSILON DELTA FRATERNITY CONVENTION, New York, N. Y., April 5-6.

SOUTHWESTERN SOCIETY OF ORTHODONTISTS, Lubbock, Texas, February 2-5.

WASHINGTON UNIVERSITY SCHOOL OF DENTISTRY SEVENTY-FIFTH ANNIVERSARY, St. Louis, Mo., April 7-12.

STATE SOCIETIES

February

Minnesota, at Minneapolis (25-27)

March

District of Columbia, at Washington (9-13)
Wisconsin, at Milwaukee (24-27)

April

Alabama, at Birmingham (8-10)
California, at San Francisco (21-23)
Connecticut, at Bridgeport (30-May 2)
Kansas, at Topeka (27-30)
Kentucky, at Louisville (7-9)
Massachusetts, at Boston (14-17)
Michigan, at Detroit (21-23)
Oklahoma, at Oklahoma City (27-30)
Panama, at Panama City
Texas, at Dallas (20)

May

Arkansas, at Fort Smith (19-21)
Georgia, at Savannah (19-21)
Illinois, at Peoria (12-15)
Indiana, at Indianapolis (19-21)
Iowa, at Des Moines (5-7)
Louisiana, at New Orleans (1-3)
Maryland, at Baltimore (5-6)
Missouri, at St. Joseph (4-7)
Montana, at Missoula (1-3)
Nebraska, at Omaha (12-14)
New Jersey, at Asbury Park (7-9)
New York, at Buffalo (12-16)
North Carolina, at Pinehurst (12-14)
North Dakota, at Fargo (12-14)
South Carolina, at Columbia
Tennessee, at Knoxville (12-15)
Virgina, at Old Point Comfort (8-10)
West Virginia, at White Sulphur Springs (19-21)

June

Colorado, at Colorado Springs (19-21)
Idaho, at Sun Valley
Maine, at Portland (26-28)

Mississippi, at Biloxi (9-11)
Nevada, at Reno (7)
New Mexico, at Albuquerque
Pennsylvania, at Bedford (3-5)
South Dakota, at Rapid City (15-17)
Utah, at Salt Lake City (26-28)
Wyoming, at Cody

July

Washington, at Portland

September

Southern California, at Los Angeles (8-10)
Hawaii, at Honolulu

November

Ohio, at Columbus

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, May 19, and at Los Angeles, June 16. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Florida, at Jacksonville, June 23-27. H. B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Georgia, at Atlanta, June 9-12. R. C. Coleman, Room 11, State Capitol, Atlanta, Secretary.

Kentucky, at Louisville, June 10-13. Leon M. Childers, 1312 First Nat'l Bank Bldg., Lexington, Secretary.

Mississippi, at Jackson, June 17. G. L. Clement, Pontotoc, Secretary.

New Jersey, June 23-28. W. A. Wilson, 148 W. State St., Trenton, Secretary.

AMERICAN ASSOCIATION OF ORTHODONTISTS

THE thirty-ninth meeting of the American Association of Orthodontists will be held at the Waldorf Astoria Hotel in New York, N. Y., May 5-8.

MAX E. ERNST, *Secretary,*
1250 Lowry Medical Arts Bldg.,
St. Paul, Minn.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

THE seventeenth annual session of the American Dental Assistants Association will be held in Houston, Texas, October 27-31. For further information, address

AILEEN M. FERGUSON,
General Secretary,
709 Centre St.,
Jamaica Plain, Mass.

AMERICAN PUBLIC HEALTH ASSOCIATION

THE seventieth annual meeting of the American Public Health Association will be held in Atlantic City, N. J., October 14-17. Headquarters, Convention Hall; residence headquarters, Hotel Traymore.

WILLIMINA RAYNE WALSH,
Associate Secretary,
1790 Broadway,
New York, N. Y.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY, INC.

THE spring meeting of the American Society for the Advancement of General Anesthesia in Dentistry will be held in New York, N. Y., Monday evening, March 24, at the Midston House, 38th St. and Madison Ave. The scientific program will begin at 8:30. Essayists: Norman Vine, Trenton, N. J., who will speak on "Care of the Patient Before, During and After Administration of Nitrous Oxide-Oxygen"; Edward Langner, New York, N. Y., on "Surgical Technic Under Nitrous Oxide-Oxygen," and Warren B. Spurge, New York, N. Y., on "Safety in the Administration of Nitrous Oxide-Oxygen for Analgesia." Dinner at 7.

M. HILLEL FELDMAN, *Secretary,*
730 Fifth Ave.,
New York, N. Y.

CHICAGO DENTAL SOCIETY

SHORTLY after January 1, the preliminary program of the Chicago Dental Society's 1941 Midwinter Meeting, to be held at the Stevens Hotel February 17-20, inclusive, was put in the mails. American Dental Association members residing within a radius of 300 miles of Chicago, as well as all dentists outside this zone who attended the 1940 meeting, received copies. Any American Dental Association member who is not in these two categories can secure a copy by addressing the Chicago Dental Society, 30 North Michigan Ave., Chicago, Ill.

LEO W. KREMER, *Secretary,*
30 North Michigan Ave.,
Chicago, Ill.

CLEVELAND DENTAL SOCIETY

THE Spring Clinic Meeting of the Cleveland Dental Society will be held May 5-7

at the Statler Hotel, Cleveland.

IRWIN F. STEUER, *Chairman,*
Publicity Committee,
308 Republic Bldg.,
Cleveland, Ohio.

DALLAS MIDWINTER DENTAL CLINIC

THE fourteenth annual meeting of the Dallas Midwinter Dental Clinic will be held in Dallas, Texas, at the Hotel Adolphus, April 21-23, immediately after an all-day session of the House of Delegates of the Texas State Dental Society, April 20. A three-day study course will be given by Fred C. Meyers, Minneapolis, Minn., on "Restorative Dentistry"; W. Clyde Davis, Lincoln, Nebr., on "Synthetic Porcelain"; George W. Christiansen, Detroit, Mich., on "Oral Surgery," and O. M. Dresen, Milwaukee, Wis., on "Prosthetic Dentistry." April 22, the members of the Dallas County Dental Society will present table clinics, after the banquet. The fee for the full three-day course is $15, including a ticket to the banquet. All members of the American Dental Association are invited. Presentation of a 1941 membership card is requested on registration.

PHELPS J. MURPHEY, *Chairman,*
Publicity Committee,
Fairmount and Welborn Sts.,
Dallas.

FIVE STATE POST GRADUATE CLINIC

THE tenth annual Five State Post Graduate Clinic of the District of Columbia Dental Society will convene at the Mayflower Hotel, Washington, March 9-13.

WALTER R. RATH, *Chairman,*
Publicity Committee.

ILLINOIS STATE ORAL HYGIENISTS' ASSOCIATION

THE annual meeting of the Illinois State Oral Hygienists' Association is to be held in conjunction with the seventy-seventh annual Midwinter Meeting of the Chicago Dental Society, at the Stevens Hotel, February 17-20. All members of the American Dental Hygienists' Association are invited to attend.

MARGARET MILLER, *Secretary,*
311 E. Chicago Ave.,
Chicago, Ill.

INTERNATIONAL COLLEGE OF DENTISTS U.S.A. SECTION

THE 1941 midwinter meeting of the U. S. A. Section of the International College of Dentists will be held at the Stevens Hotel, Chicago, February 16.

ELMER S. BEST, *Registrar,*
801 Medical Arts Bldg.,
Minneapolis, Minn.

KANSAS CITY-WESTERN DENTAL COLLEGE DIAMOND JUBILEE

THE Diamond Jubilee of the Kansas City-Western Dental College will be held March 24-25, with headquarters at the Hotel Muehlebach, Kansas City, Mo. All ethical dentists are invited to attend and to present clinics.

R. J. RINEHART, *Dean,*
Tenth St. and Troost Ave.,
Kansas City, Mo.

ALUMNI SOCIETY OF THE PHILADELPHIA DENTAL COLLEGE

THE seventy-eighth annual session of the Alumni Society of the Philadelphia Dental College (Temple University School of Dentistry) will be held May 21-22, with scientific sessions, forum, clinics and the annual reunion banquet and dance.

DAVID K. WALDMAN, *Editor.*

GREATER PHILADELPHIA ANNUAL MEETING

THE Greater Philadelphia Annual Meeting will be held February 4-7, at the Benjamin Franklin Hotel.

ABRAHAM COHEN, *Chairman,*
Publicity Committee,
269 South 19th St.,
Philadelphia, Pa.

PACIFIC COAST SOCIETY OF ORTHODONTISTS

THE eighteenth general meeting of the Pacific Coast Society of Orthodontists will be held at the Palace Hotel in San Francisco, Calif., February 20-22.

EARL L. LUSSIER, *Secretary,*
450 Sutter Bldg.,
San Francisco, Calif.

PIERRE FAUCHARD ACADEMY

THE midwinter meeting of the Pierre Fauchard Academy will be held in the Stevens Hotel, Chicago, February 17.

ELMER S. BEST, *Editor,*
Essex Bldg.,
Minneapolis, Minn.

ST. LOUIS UNIVERSITY DENTAL ALUMNI ASSOCIATION

THE St. Louis University Dental Alumni Association will hold its annual reunion March 5-6 at the dental school building, 3556 Caroline St., St. Louis.

OTTO C. HERMANN, *Chairman,*
Publicity Committee,
3115 S. Grand Blvd.,
St. Louis, Mo.

SIGMA EPSILON DELTA FRATERNITY CONVENTION

THE Sigma Epsilon Dental Fraternity will celebrate its fortieth anniversary April 5-6 at the Hotel Pennsylvania, New York, N. Y. For further information, address

DAN KOLLEN,
24 W. 59th St.,
New York, N. Y.

SOUTHWESTERN SOCIETY OF ORTHODONTISTS

THE twentieth annual meeting of the Southwestern Society of Orthodontists will be held at the Hilton Hotel, Lubbock, Texas, February 2-5.

R. E. OLSON, *Secretary,*
Union Nat'l Bank Bldg.,
Wichita, Kan.

WASHINGTON UNIVERSITY SCHOOL OF DENTISTRY SEVENTY-FIFTH ANNIVERSARY

WASHINGTON UNIVERSITY SCHOOL OF DENTISTRY, St. Louis, Mo., will celebrate its seventy-fifth anniversary April 7-12, under the sponsorship of the dental alumni association. The week will be devoted to lectures and refresher courses. The profession is invited to participate. For further information, address the Seventy-Fifth Anniversary Committee, 4952 Maryland Ave., St. Louis, Mo.

ALABAMA DENTAL ASSOCIATION

THE seventy-second session of the Alabama Dental Association will be held at the Tutwiler Hotel, Birmingham, April 8-10, celebrating the centennial of the world's first dental law, which was enacted in Alabama in 1841.

GEORGE W. MATTHEWS, *Secretary,*
905 Protective Life Bldg.,
Birmingham.

SOUTHERN CALIFORNIA STATE DENTAL ASSOCIATION

THE next annual meeting of the Southern California State Dental Association will be held September 8-10 at the Los Angeles Biltmore Hotel.

FRANCIS J. CONLEY, *Secretary,*
804 Professional Bldg.,
Los Angeles.

GEORGIA DENTAL ASSOCIATION

THE seventy-third annual meeting of the Georgia Dental Association will be held at Savannah, May 19-21, with headquarters at the Hotel DeSoto.

R. H. MURPHY, *Secretary,*
Macon.

ILLINOIS STATE DENTAL SOCIETY

THE next annual meeting of the Illinois State Dental Society will be held in Peoria, May 12-15.

L. H. JACOB, *Secretary,*
Jefferson Building,
Peoria.

KANSAS STATE DENTAL ASSOCIATION

THE seventieth annual session of the Kansas State Dental Association will be held in the Municipal Auditorium, Topeka, April 27-30.

FRED A. RICHMOND, *Secretary,*
Huron Building,
Kansas City.

KENTUCKY STATE DENTAL ASSOCIATION

THE eighty-first annual meeting of the Kentucky State Dental Association will be held at the Brown Hotel, Louisville, April 7-9.

J. L. WALKER, *Secretary,*
640 Barbee Way South,
Louisville.

LOUISIANA STATE DENTAL SOCIETY

THE sixty-first annual meeting of the Louisiana State Dental Society will be held May 1-3, at the Roosevelt Hotel, New Orleans.

JULIAN S. BERNHARD, *Secretary,*
417 Medical Arts Bldg.,
Shreveport.

MASSACHUSETTS DENTAL SOCIETY

THE Massachusetts Dental Society will meet April 14-17.

PHILIP E. ADAMS,
106 Marlboro St.,
Boston.

MICHIGAN STATE DENTAL SOCIETY

THE eighty-fifth annual meeting of the Michigan State Dental Society will be held in Detroit, April 21-23.

WILLIAM R. DAVIS, *Secretary,*
Michigan Dept. of Health,
Lansing.

MINNESOTA STATE DENTAL ASSOCIATION

THE fifty-eighth annual session of the Minnesota State Dental Association will be held in the Municipal Auditorium, Minneapolis, February 25-27.

L. M. CRUTTENDEN, *Secretary,*
498 Lowry Medical Arts Bldg.,
St. Paul.

MISSOURI STATE DENTAL ASSOCIATION

THE Missouri State Dental Association will hold its next meeting in St. Joseph, May 4-7.

C. W. DIGGS, *Secretary,*
Exchange National Bank Bldg.,
Columbia.

MONTANA STATE DENTAL ASSOCIATION

THE thirty-eighth annual session of the Montana State Dental Association will be held in Missoula, May 1-3.

T. T. RIDER, *Secretary,*
9 Higgins Block,
Missoula.

NEW JERSEY STATE DENTAL SOCIETY

THE next annual meeting of the New Jersey State Dental Society will be held in Asbury Park, May 7-9, at the Berkeley Carteret Hotel.

F. K. HEAZELTON, *Secretary,*
223 E. Hanover St.,
Trenton.

DENTAL SOCIETY OF THE STATE OF NEW YORK

THE Dental Society of the State of New York will convene in Buffalo for its seventy-third annual meeting, May 12-16, at the Statler Hotel. Members of the American Dental Association and the Canadian Dental Association are invited.

LEON J. GAUCHAT, *Chairman,*
Press and Publications,
333 Linwood Ave.,
Buffalo.

PENNSYLVANIA STATE DENTAL SOCIETY

THE seventy-third annual meeting of the Pennsylvania State Dental Society will be held at the Bedford Springs Hotel, Bedford, June 3-5.

C. J. HOLLISTER,
Executive Secretary,
217 State St.,
Harrisburg.

OKLAHOMA STATE DENTAL SOCIETY

THE next meeting of the Oklahoma State Dental Society will be held in Oklahoma City, April 27-30.

O. W. BOYER, *Secretary,*
Perry.

TENNESSEE STATE DENTAL ASSOCIATION

THE seventy-fourth annual meeting of the Tennessee State Dental Association will be held at the Hotel Andrew Johnson, Knoxville, May 12-15.

HOWARD M. TAYLOR, *Secretary,*
206 Medical Arts Bldg.,
Knoxville.

VIRGINIA STATE DENTAL ASSOCIATION

THE next annual meeting of the Virginia State Dental Association will be held at the Chamberlain Hotel, Old Point Comfort, May 8-10.

J. E. JOHN, *Secretary,*
Medical Arts Bldg.,
Roanoke.

WISCONSIN STATE DENTAL SOCIETY

(Correction)

THE Wisconsin State Dental Society will meet March 24-27, at Milwaukee.

STATE OF CALIFORNIA BOARD OF DENTAL EXAMINERS

THE next examinations of the Board of Dental Examiners of California for license to practice dentistry and for license to practice dental hygiene in the State of California will be held in San Francisco, commencing May 19, at the Physicians & Surgeons College of Dentistry, 344 Fourteenth St., and the University of California, College of Dentistry, Third and Parnassus Ave. There will also be an examination in Los Angeles in Room 804, City Hall, and the University of Southern California, College of Den-

tistry, 122 E. Sixteenth St., commencing June 16. All credentials must be in the office of the secretary, Room 203, 515 Van Ness Ave., San Francisco, at least twenty days prior to the date of any examination. Address all communications to Kenneth I. Nesbitt, Secretary.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

THE Florida State Board of Dental Examiners will hold its annual examination of applicants for license to practice dentistry and dental hygiene in Florida at Jacksonville in the Seminole Hotel, June 23-27. Preliminary applications must be filed by April 23. Final application for examinations in dentistry and in dental hygiene must be complete by May 23. Address all communications to

H. B. PATTISHALL, *Secretary,*
351 St. James Bldg.,
Jacksonville.

BOARD OF DENTAL EXAMINERS OF GEORGIA

THE Georgia Board of Dental Examiners will meet June 9-12 at the State Capitol. For application blanks, address

R. C. COLEMAN, *Joint Secretary,*
Room 111, State Capitol,
Atlanta.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the Kentucky State Board of Dental Examiners will be held June 10-13, 1941 at the University of Louisville, Dental School, Louisville. Dentists having graduated prior to 1941 and desiring to stand examination before this board must have filed application, complete with full information requested, at this office not later than April 10. Applications of 1941 graduates must be in our file by May 30. Ample time should be allowed for securing all data required. For application forms and further information, apply to

LEON M. CHILDERS, *Secretary,*
1312 First Nat'l Bank Bldg.,
Lexington.

MISSISSIPPI STATE BOARD OF DENTAL EXAMINERS

THE Mississippi State Board of Dental Examiners will hold its next examination in Jackson beginning the third Tuesday in June 1941. Applications should be in the hands of the secretary thirty days before the date of the meeting. For further information, address

G. L. CLEMENT, *Secretary,*
Pontotoc.

STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY OF NEW JERSEY

THE State Board of Registration and Examination in Dentistry of New Jersey will hold its annual examinations, commencing June 23 and continuing for five days thereafter. On application to the secretary, a copy of the requirements and rules for applicants, instruction sheet and preliminary application blank will be sent. Any person desiring to apply as a candidate must file the preliminary application blank, together with the examination fee of $25, on or before March 15, for the succeeding June examinations or before September 1 for the succeeding December examinations.

W. A. WILSON, *Secretary,*
148 W. State St.,
Trenton.

REFRESHER COURSES IN PERIODONTIA, SCHOOL OF DENTAL AND ORAL SURGERY, COLUMBIA UNIVERSITY, NEW YORK CITY

THE School of Dental and Oral Surgery, Columbia University, offers two refresher courses in periodontia: 1. A ten-day intensive course of lectures, discussions and clinical practice. Fee $100. 2. An extended course, one-half day per week for two sessions, of lectures, discussions and supervised technical treatment. Fee $30 for each session.

THE courses outlined in this announcement, given at the School of Dental and Oral Surgery, Columbia University, are designed to be "refresher" courses bringing practitioners abreast of modern undergraduate teaching in theory and practice in the subject.

Admission to the course is limited to qualified graduates in dentistry who are members in good standing of the American Dental Association or recognized sectional organizations. In the case of foreign applicants, membership in the applicant's national dental organization is required.

Applicants should fill in an application blank and forward it with a money order or check for the $10 reservation deposit to the assistant to the registrar, School of Dental and Oral Surgery, 630 West 168th Street, New York, N. Y.

POSTGRADUATE COURSE IN PERIODONTIA, NEW YORK UNIVERSITY COLLEGE OF DENTISTRY

NEW YORK University College of Dentistry will hold its eighth annual postgraduate course in periodontia for twenty sessions, as follows: Schedule A: Morning and afternoon sessions, June 16-27. Schedule B: Morning and afternoon sessions, June 16-18; mornings only, June 19 to July 9. All dates are inclusive. Fee $100. The course is limited to fifteen. Preference will be given in the order of receipt of application. The course will include the etiology, diagnosis and treatment of periodontal disease; various technics of pocket eradication, with conservative treatment stressed; Vincent's infection; diagnosis of types of bone resorption; mouth manifestations of systemic disease; periodontal foci of infection; toothbrushing; instrumentation; balancing of occlusion. Courses are taught by lectures and clinical work, each student treating several cases. Instruction will be given by Samuel Charles Miller, Sidney Sorrin, J. Lewis Blass and the entire periodontia faculty.

For further information and application, address the office of the dean, New York University College of Dentistry, 209 E. 23rd St., New York, N. Y.

DENTAL INTERNSHIPS

APPLICATIONS for dental internships are now being received at the Baltimore (Md.) City Hospitals. Senior students interested can obtain application blanks by writing to the superintendent, Baltimore City Hospitals, 4940 Eastern Ave., Baltimore, Md. Applications should be in February 1.

P. J. MCMILLIN, *Superintendent.*

DENTAL INTERNSHIP, BARONESS ERLANGER HOSPITAL

THE Baroness Erlanger Hospital of Chattanooga, Tenn., has recently established facilities for a dental internship and is very desirous of filling the position. This 500-bed hospital, owned by the city and county, has recently established and equipped a dental clinic.

RESEARCH FELLOWSHIPS IN MEDICINE AND DENTISTRY BY THE GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS

THE Graduate School of the University of Illinois has established four research fellowships to be awarded for one year in the fields of medicine and dentistry in Chicago at a stipend of $1,200 per year (calendar year with one month's vacation). Fellows are eligible for reappointment in competition with the new applicants.

Candidates for these fellowships must have completed a training of not less than eight years beyond high school graduation. This training may have been acquired in any one of the following ways, or the equivalent thereof:

1. Work leading to the B.S. and M.D. degrees. (In some instances, the candidates would have the M.S. degree, or an additional year or two of hospital training beyond the intern year).

2. Work leading to the B.S., M.S. and D.D.S. degrees.

3 Work leading to the B.S. or B.A. degree in a four-year collegiate course and to the D.D.S. degree.

4. Work leading to the B.S., D.D.S. and M.D. degrees.

Candidates should indicate the field of research in which they are interested and submit complete transcripts of their scholastic credits, together with the names of three former science teachers as references. March 1 is the deadline for acceptance of applications. Announcement of the fellowship awards will be made April 1, becoming effective September 1.

Formal application blanks can be secured from the secretary of the Committee on Graduate Work in Medicine and Dentistry, 1853 W. Polk St., Chicago, Ill.

CIVILIAN DENTISTS WANTED FOR DUTY WITH CIVILIAN CONSERVATION CORPS

A NUMBER of vacancies will exist in the Civilian Conservation Corps in the Eighth Corps Area wherein the services of dentists can be utilized as civilian employes (dentists) or as contract dentists. Applicants must

be graduates of Class A dental schools. Applications should be addressed to the Surgeon, CCC, Headquarters Eighth Corps Area, Fort Sam Houston, Texas. Consideration will be given to applicants as follows:

1. Dental Reserve Corps officers can be placed on duty under Classification P-2 at the initial rate of pay of $2,600 a year.

2. Dentists who are not members of the Dental Reserve Corps can be placed on duty as contract dentists at the initial rate of pay of $2,600 a year.

Both of the above-mentioned groups must consider themselves physically qualified and, if selected, they must report to their first place of assignment at their own expense. If found physically qualified at that time, they will be appointed at the respective rates. Upon being relieved from duty either at their own request or for the convenience of the government, the dentist must bear the expense of return transportation.

OMICRON KAPPA UPSILON

COMPLYING with the recent resolution of the Supreme Chapter of Omicron Kappa Upsilon, the secretary's office states that it is now possible to obtain a certificate suitable for framing, at a cost of $1. Request should be made to the local chapter secretary, who will forward it to this office. Give the name as it should appear on the certificate and year of election.

GEORGE W. TEUSCHER, *Secretary*,
311 E. Chicago Ave.,
Chicago, Ill.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING DECEMBER 1940

December 3

No. 2,223,484, JOSEPH J. ENGELBREIT. Mouth hygiene kit.

No. 2,223,629, ALBERT LANGE. Mold and sterilizer for dental impression compounds.

No. 2,223,952, THOMAS P. DARMODY. Individual toothbrush and tooth cleanser service package.

December 10

No. 2,224,225, WILFRED JAMES HOLROYD. Dentist's illuminating lamp and projector.

No. 2,224,264, MAX JEANNERET. Dentist's device.

No. 2,224,511, HENRY M. CLEVEN. Denture connector.

No. 2,224,788, CONRAD JOBST. Brush.

December 17

No. 2,224,967, NATHAN G. KAYE. Dental appliance.

No. 2,225,201, EMIL EINER WILHELM ANDERSON. Apparatus for administering anesthesia.

No. 2,225,284, WILLIAM M. MCDONALD. Oral prophylactic.

No. 2,225,331, CHARLES M. CAMPBELL. Rubber bristle toothbrush.

December 24

No. 2,225,857, AVERY HOBART CHENOWETH. Means for making dentures.

No. 2,225,900, CHARLES P. BOWER. Amalgam carrier.

No. 2,226,079, JAKOB SPANNER. Dental alloy.

No. 2,226,145, CALVIN L. SMITH. Motor driven tooth cleaning device.

December 31

No. 2,226,616, MICHAEL KRAUS. Electric lighting device for the drill head of a dental drill.

No. 2,226,663, LEE R. HILL and ALBERT G. SUMMER. Fountain toothbrush.

No. 2,226,814, HAROLD E. GREGG. Toothbrush handle.

No. 2,227,278, JONAH SALIT. Gum massaging device.

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